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Twenty-one Inch Engine Lathe.

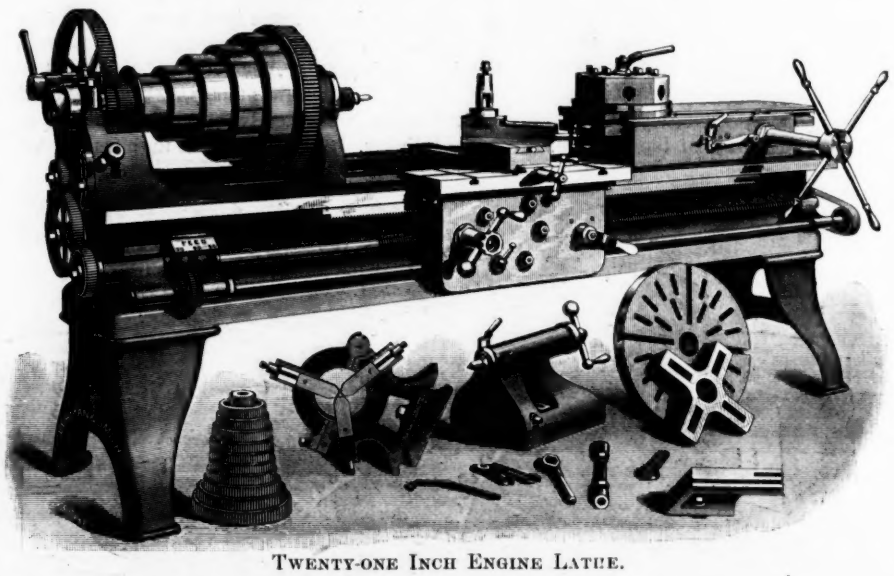
With this we illustrate a 21-inch lathe built by Beaman & Smith, of Providence, R. I., which is much the same as the 16-inch lathe by the same builders, which we illustrated in our issue of June 27 last, except that this has a compound rest on the carriage and is fitted with a turret head and slide, as shown, when desired. The slide has an automatic feed driven by a pulley and belt from the end of the feed rod, as shown, and also has an automatic stop for the feed. The travel of the slide is 12½ inches, and the turret is made hexagonal in form, to enable tools to be fastened to it, when required, more firmly than would be possible by means of the hole alone. It has six holes $1\frac{11}{16}$ inch diameter, and a hole the same size through the central stud allows stock to be passed through the turret when desired.

The slide is adjustable vertically and laterally, to compensate for wear, so that it can always be kept accurately in line with the lathe spindles. The bed of the machine is 14½ inches wide, 11½ inches deep, well tied and very heavy.

The head has a cone pulley of five steps, the largest 16 inches, the smallest 6 inches diameter, for 3-inch belt. In connection with the back gearing, which is in the ratio of 12½ to 1, gives 10 properly arranged speeds to the spindle, which runs in hard bronze boxes, and has a hole $1\frac{13}{16}$ inches diameter, through its entire length. The front bearing is 4 inches diameter, 6 inches long, and the back bearing 3 inches diameter, 3½ inches long.

The foot-stock spindle is 2½ inches diameter, 15 inches long.

The apron is attached to carriage by four accessible screws, and contains strong gearing for both direct and cross feed, which are entirely independent of each other.



TWENTY-ONE INCH ENGINE LATHE.

The feeds are positive by means of quickly changed gearing, giving any required ratio, some of the special mechanism for accomplishing this being shown on the front of the bed below the head. It was illustrated by a detail cut in our issue referred to above.

Attachments consist of center rest, screw cutting gears, countershaft, two face plates and wrenches. Countershaft pulleys are 14 inches diameter for 3¼ inch belt, and should make 125 turns per minute. The weight of the lathe without turret is 4,550 lbs.

Improved Wood-Working Machinery.

The variety wood-worker illustrated on this page has been newly designed by the builders, J. A. Fay & Co., Cincinnati, Ohio, in answer to a demand from wagon, agricultural implement, car and locomotive manufacturers for a large and heavy machine capable of doing a wide variety of work on large timbers and wide material. It is not only capable of the heaviest work, but, owing to its massiveness and stability, does the lighter work to a degree of perfection not hitherto attained.

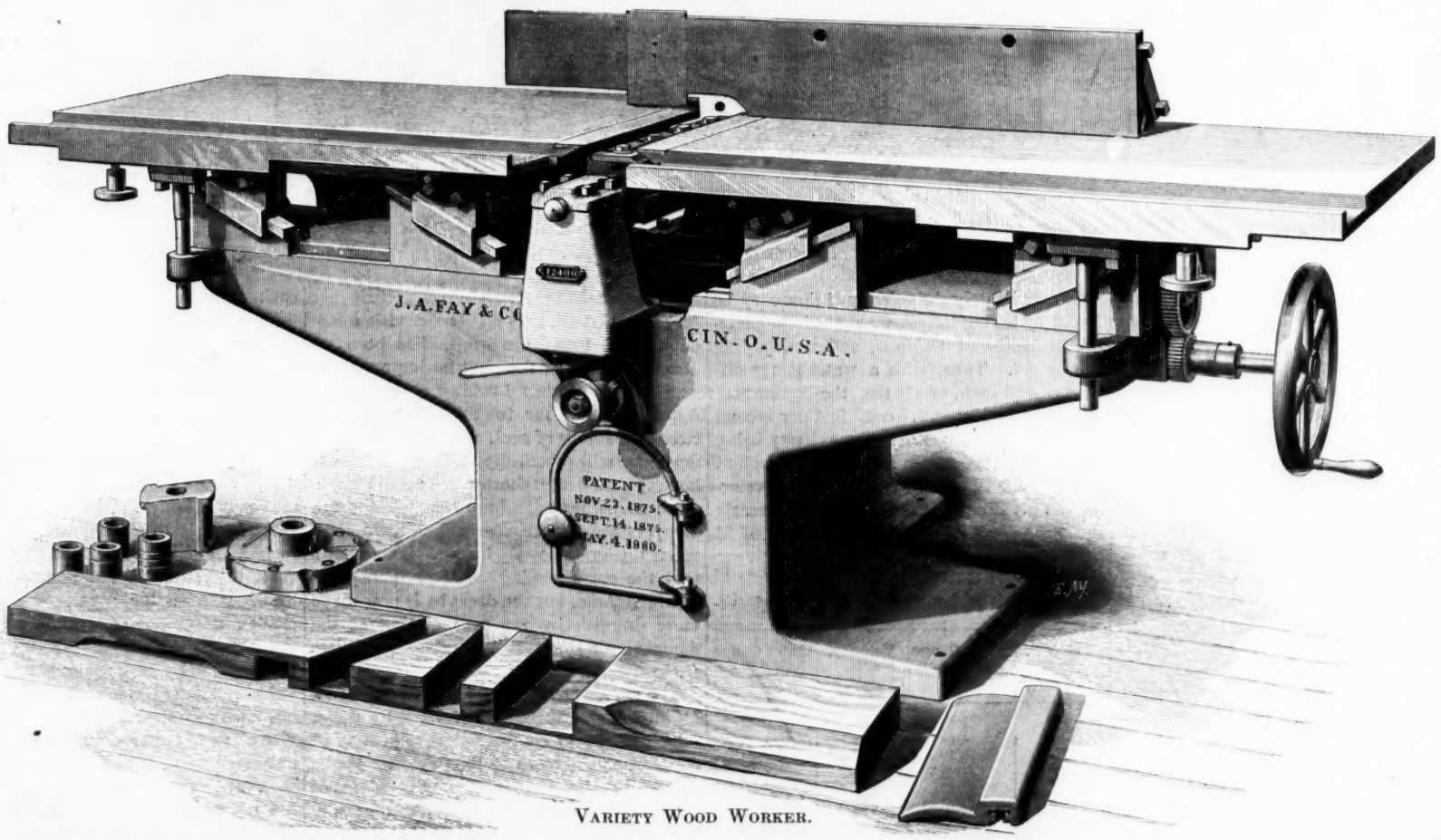
It will plane out of wind, surface straight or tapering, rabbet, joint, bevel, gain, chamfer, plow, make glue joints, square up, etc., raise panels either square, bevel, or ogee, stick beads, work circular moulding, rip, cross-cut, tenon, rout, bore, etc.

It is furnished with one 16″ four-side steel slotted head, rabbeting, jointing, and capped heads, and it is fitted to receive expansion grooving or paneling heads. When desired, it can be equipped with a boring and routing table, having vertical and lateral adjustments to suit the size of stuff to be worked.

The tables are made of iron, planed true, and have independent vertical and lateral adjustments by means of the hand-wheel at the working end of the machine. When facing and planing out of wind, the vertical and lateral adjustments can be made simultaneously, thus constantly retaining the proper distance between the periphery of cut and edge of table.

All the different functions of the machine are secured by the use of two tables, thereby effecting a saving of time in making the adjustments. The tables are made with grooves to receive the gaining frame, and are made continuous by filling pieces connected with them when so used. For sawing, a short supplemental table is inserted between the other two, making a continuous saw table.

The arbor is of steel, of large diameter, and revolves in three bearings supported on the column. The bearing on the front side of the machine is planed in a seat, the height of which to the center of the arbor is equal to one-half the diameter of the largest head to be used. It is readily detachable for the purpose of substituting different heads. This is very important, as it gives greater stability to the arbor, and obviates its liability to



VARIETY WOOD WORKER.

spring. The bearings on the back of the machine are planed and gibbed in a seat and have a lateral movement with the spindle and cutter head, for accuracy of adjustment in gaining, rabbeting, etc. This movement is accomplished by means of a small hand-wheel on the front side of the machine.

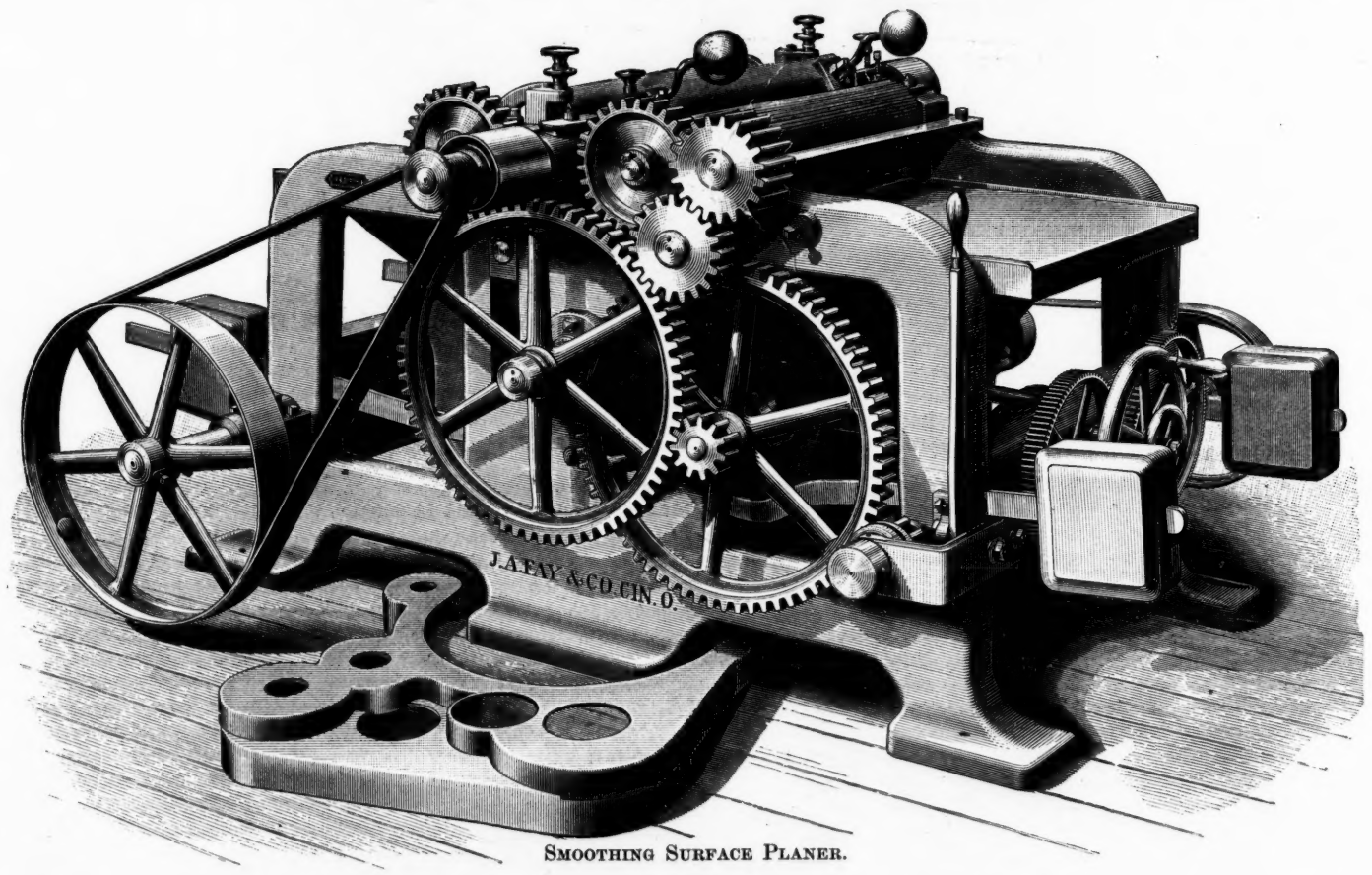
Another important advantage will be found in the fence, which requires no separate adjustment. Being attached to and forming a part of the forward table, it always maintains its proper position in relation to the knives. It is adjustable across the table, is fitted to receive pressure springs for holding down the stuff, and swings to different angles for beveling work.

A safety guard is supplied with the machine for covering such portion of the planing head as may not be used in working narrow material.

In the range and variety of work for which the machine is adapted, readiness of adjustment, the ease with which it is operated and kept in order, the accuracy and rapidity with which the work is performed, economy of shop room, and in durability of construction and labor-saving qualities, the machine has been found entirely satisfactory.

Cylinder pulley is $4\frac{1}{2}''$x$8\frac{1}{2}''$, and should make 3,660 revolutions.

The demand for a first-class surface planing machine for reducing the lumber used in furniture and cabinet making, panel and other work, to an even thickness, and leave a smooth, clean surface, requiring little labor to prepare it for the varnish room, has led to the designing of the improved smoothing planer illustrated herewith and which is built by the same makers. The conditions necessary to do this kind of work are numerous, and it is believed have been fully met in this construction.



SMOOTHING SURFACE PLANER.

The cored frame is heavy and substantial in every part, with the metal so distributed as to withstand any strain it may be subjected to. It has four driven feed rolls, 5″ in diameter, connected by a train of heavy expansion gears, making a strong and powerful feed. The two lower rolls raise and lower with the bed, while the upper are held in position by weights. The table is supported on long inclines raised and lowered by a hand-wheel and two screws in front.

The cylinder and heavy journals are made of solid forged steel, and belted at each end. The cylinder is lipped for cross-grained or knotty lumber, runs in fixed bearings, and as the bed elevates and lowers to suit the thickness of the material to be worked, it always remains in the same position.

Self-adjusting pressure bars are placed on each side of the cylinder before and after the cut, so arranged as to always retain the same relative position to the cylinder, without regard to the varying thickness or inequality of the lumber being planed. This arrangement admits of planing short stuff without clipping.

The feed has four speeds, to suit different kinds of work. It can be instantly started and stopped at the will of the operator. The machine is constructed in the most thorough and substantial manner; all joints are planed, holes reamed, bolts turned, and nothing omitted to make this the most perfect surface planing machine built. Four sizes are made, to plane 24″, 26″, 30″, and 36″ in width, and from 1-16″ to 6″ in thickness, with changes of speed. The weight of the 24″ machine and countershaft, boxed for shipment, is about 4,050 pounds; the 26″, about 4,330 pounds; the 30″, about 4,560 pounds; the 36″, about 5,000. The cylinder pulleys are 5″ diameter and 5″ face, and should make 4,000 revolutions.

When a countershaft is required, it is furnished with tight and loose pulleys 12″x6″ that should make 900 revolutions.

Chimney Suction.

BY W. H. BOOTH.

III.

In experiments on furnaces it is desirable to know the water gauge at different parts of a furnace, and its flues. This is often useful in determining the velocity of movement of the gases or from the velocity of movement the pressure is found. For the low-pressure differences of furnaces it is usual to take it that the pressure varies as the square of the velocity, and, conversely, the velocity varies as the square root of the pressure.

Approximately the velocity of flow may be found by taking the square root of the pressure in 100ths of an inch, and multiplying this by 4.7. Thus, with a water gauge difference of 1 inch, or $\frac{100}{100}$ ths, the square root of 100 is 10 and $10 \times 4.7 = 47$ feet per second of velocity. Conversely, the velocity being known, the pressure in 100ths of an inch of water gauge is found by squaring the velocity and dividing by 22, which is very nearly the square of 4.7. Thus for a velocity of 21 feet we get a pressure of $\frac{21 \times 21}{22} = 20.05$ hundredths. It is just on this point of draught velocity that much depends in respect to successful firing of a boiler. When a boiler is too big for its work, by which we mean, that with usual proportions, its great area is far too large for practical purposes, the amount of fuel burned will have to be controlled by closing the chimney damper in order to moderate the combustion. Now the closing of the damper is for the purpose of reducing the intensity of combustion and the make of steam, and implies a colder fire, through which air is sluggishly passing. Even a sluggish fire burns away, and demands occasional fresh fuel, and when this is put on it gives off gases which demand air to burn them. The sluggish draught, however, is wholly incompetent to draw in through the provided openings in the door or at the bridge this necessary air supply, and it is therefore on this account that I am accustomed to advise the employment of ash-pit dampers in hand-fired furnaces in order that, the chimney damper being open, there will be the fullest freedom for air to flow in when needed. Of course this air supply must not be continuous; it must last two or at most three minutes as a rule after each fresh charge.

Velocity, feet, per second.	Water Gauge 100ths of an inch.	Velocity, feet, per second.	Water Gauge 100ths of an inch.
5	1.13	40	72.48
10	4.53	45	91.73
15	10.19	50	113.25
20	18.12	55	137.03
25	28.31	60	163.08
30	40.77	65	197.32
35	55.50	70	222.00

Attention has been drawn to the use of thick fires. Some weeks ago I was consulted by a firm of steam users near the center of London as to their boiler. Inspection revealed a two furnace boiler with a grate about six feet in length, or a total grate area of about 27 feet, burning coal at the rate of about 10 pounds per foot, per hour. The draught was good, and needless to say the back end of the grates was merely covered with ash and clinker. Shortening so as to burn the very excellent coal at the rate of 20 pounds per foot was advised, and on second visit a few days ago I found the grates had been reduced to about $4\frac{1}{2}$ feet, but no improvement seemed to be made. Looking at the fires, I found them still far too thin, especially between the lumps of coal, and the back of the grate was still practically bare. It appeared, however, that the shorter grates had made some steps towards improvement, for the dampers were more closely shut down than when the grates were longer. This shows that the gases passing to the chimney are less in volume, but the draught is now made more sluggish by the near closing of the dampers, and probably combustion is less perfect.

The advice now is to cover with fire-brick all but the first three feet of bars, by doing which I hope to compel a wider opening of damper, and to increase the thickness of the fire so that the passage of large streams of cold air through thin places shall be prevented. Those who have fired hard coal know that a fire may be so chilled at a thin place as to go dead. This does not take place so visibly with soft coals, but the same takes place in a less degree. The first moderate curtailment of the grates has shown the fireman that he can at least keep steam as easily as before, and when he finds how easy it will be to attend to a grate only three feet long it is yet possible that we may shorten still further.

Anyhow, it is my expectation, that in place of using an expensive fuel, we shall use one much less expensive and freer from big lumps, which are not always the best for a fire, as they are apt to cause too much concentration of air current and usually cost more, also. By these means it is probable that, when the fireman finds himself compelled to keep no part of the fire less than six or eight inches in thickness, he will find also that the damper will be very much wider than it now is, and with a greater intensity of heat in the fire, the combustion of the carbon will be more complete, and less air will be used, or rather passed through, per pound of fuel, while at the same time the openings for extra air to burn the gas from the fresh charges of fuel will admit the necessary air, for the open damper will allow such to enter at something higher than the fifteen feet per second velocity which practical experience seems to indicate as the minimum draft to insure smokelessness. This corresponds to a water gauge of $\frac{1}{10}$th of an inch, and $\frac{9}{10}$ths, corresponding to about 21 feet, is not a poor draught, whilst with a draught velocity of 30 feet per second anything may be done with a furnace.

When a draught is poor because of a too small area of chimney, it is obviously absurd to seek to remedy this by increasing the grate area. The proper remedy in such cases is a rocking grate with the largest possible air spaces. With this the air spaces can be kept constantly clear, and the fire, though fairly thick, open and clean. Many firemen are inclined to lengthen the grate for a poor draught in order to burn sufficient coal, and no doubt are frequently forced to this by the choking of a fixed grate. It is impossible to enumerate the various devices, each claiming to be infallible, that are offered to steam boiler users in the shape of grates, bridges, blowers, air openings, etc., and all of which are claimed as the one and only cure for every fault and form of furnace. Now the truth is that each furnace is a law unto itself, and demands special treatment, and an appliance that admirably suits the boilers at Mr. A.'s flouring mill may wholly fail to act at that of Mr. B., which is to all appearances in every respect similar, and may, in fact, differ by a very little indeed. The addition of a pipe, the shape of a flue cover, may completely change the behavior of a furnace, and no steam user should involve himself in trouble and expense by purchasing patent appliances unless guided by his own knowledge, if he has such technical knowledge, or by the advice of an engineer competent to advise. I have seen an outlay of $4,000 thrown to one side, after less than a year's use, and replaced by satisfactory appliances costing about $600, entirely through want of care and thought in the outlay of the larger sum, and from the objection to call in and pay for advice which, as it weighs nothing, is not valued by men who deal in ponderable articles, and cannot understand that simple knowledge and experience, coupled with perhaps a short 5 or 10 minutes' inspection, will sometimes save thousands of dollars.

There are so many points connected with fuel economy, that a thorough experience alone can point out proper practice in any individual case.

For example, a boiler capable of evaporating a certain amount of water, per pound of fuel, evaporates a ton of water in a certain period of time. By increasing the amount of fuel burned, the boiler will give a larger duty, but this does not necessarily imply that it will continue to evaporate the same weight of water, per pound of fuel, for there is to be considered the ratio of fuel burned to heating surface, or, as it should be more correctly termed, absorbing surface. Common practice takes cognizance of the ratio of grate to heating surface, but this is clearly inaccurate, or at least misleading, for the weight of fuel burned under the boiler may be anything from 8 to 28 pounds per square foot. When, for ideas of economy, it is desired to alter the conditions as regards draught of a boiler, the evaporation of which is good per pound of fuel, care should be taken that, in increasing the draught, and therefore the rate of combustion per unit of grate area, this same grate area will be probably too great for the amount of heat now being generated, and must be reduced.

In any set of boilers too small for their work, they may be made to do more work by an assisted draught, and will, so far as perfection of combustion is concerned, be more economical; but if forced beyond their power of heat absorption, loss must occur. In every well-designed steam plant, then, an improvement of draught requires to be accompanied by a corresponding curtailment of grate area, if it is desired that loss of fuel shall not take place. When an improvement of draught is effected, and no more work demanded from a boiler, the result of improved draught must often be disastrous; for the fuel in such a case will burn away without producing useful effect, or the bars will burn off bare in places, and the surplus draught will simply rush through such places, and cool down the boiler so much as to compel a greater than needful amount of fuel to be used. Thus a grate of too large area tends actually to be a cause for its own magnitude, for it admits cold, useless air on one part, and demands fuel burning on another part to heat such cold air. It tends, in fact, to keep itself covered with fuel until its surplus area is so far under burning as to reduce the inrush of cold air to such a point as not to require any further fuel to heat it up.

If, on inspecting such a grate, it appeared that a good fire existed over a length of five feet, and the end half-foot was bare, it would be at once necessary to reduce the grate by half a foot. But this reduction of half a foot of bare bars would stop the inrush of useless air, and this being no longer able to act as a cooling agent, the boiler would gather heat, and the safety valves would blow until perhaps the bars again got bare for two inches or so, which would admit air again and keep the temperature down. Hence, in place of having shortened the grate a half foot, we should really take off nine inches at once or even more, so as to remove not merely the visible bare grate, but also such portion of the covered grate as is covered by virtue of the heat-absorbing requirements of the uncovered portion.

In firing, as a rule, it is to be observed that it is almost universal practice to keep up a good thick fire at the front, gradually sloping back to the bridge to mere ash or clinker only too frequently.

If firemen would adopt the rule of firing up against the bridge, and letting the fire slope toward the front, they would be placed in a better position for observing the state of their fires. They would be sure at a glance that the bars at back were not bare, not always easy to see in many cases, and if they had too long a grate, they would see this at once also, for the bare portion would be in front where the fire bed was thinnest. If wise, they would cover this by a temporary dead plate and shorten the grate next time they had a chance to let up. A longitudinal section of two fires stoked in the two methods is seen in Figs. 1 and 2.

The advantage of the method of Fig. 2, apart from its visibility, is that its surface is better presented to the air admitted at the door, and the depth of fire on the back bars is such that, when the steam supply is variable, any sudden call for steam may be quickly responded to by proper use of the damper—the mass of incandescent fuel being ready to give off heat at once, on being drawn up by the increased air supply. Such a fire is in no way wasteful; as the time arrives for stopping it can be gradually burned down, and when burned low and thin it is in no worse condition than the common form of thin fire has been all day. Seen in cross-section the newer form of fire would be crowned, being much thicker at the middle than at the sides. The advantage of thus firing up the middle seems to be that the larger lumps of fuel fall towards the sides, where they continue to evolve hydrogens far longer than the smaller fuel at the center, and so utilize the surplus oxygen, which comes up in greater volume at the thinner sides. Generally, the furnace is in a more balanced state and better able to perform its duties economically.

The Modern Steam Plant and Its Management.

BY PETER H. BULLOCK.

KEEP ALL YOUR WITS ABOUT YOU.

There is a great difference in methods among engineers about managing their apparatus, some continually looking for defects that are not in any way manifest, while others let things alone until there is some evidence to warrant investigation. No rule can be laid down for the safe guidance in all cases, for conditions differ so much that what might be safe and proper in some cases would be wholly wrong in others. Perhaps there is no occupation where all the different senses are called into service more than in the management of a steam plant, and it is my opinion that no defect can exist in the apparatus that will not make itself manifest to some of them if intelligently directed and trained in that direction. The critical eye discovers irregularities due to lost motion of parts, or slight movements of parts that should be stationary. Anything that is unusual or improper at once attracts the attention of the person whose business it is to make timely discovery of such things.

An engineer friend saw a drop of oil under a trussed bearing in such a position that it could not have come there from any of the regular channels. The part was wiped, and the next day still more oil was found there, and an examination showed that the bearing was fractured in such a way as to invite further trouble.

A shaft was seen to be two inches further through a hanger than usual, while the other end of the line was in its usual and proper place. It was found that one length was working out of its coupling hub, and was about ready to give several hundred of employes an enforced vacation, as the shaft was heavily loaded with work and pulleys, and it would surely have been bent or broken had it cleared the coupling.

A large pulley that had always run taut on its face was seen to give a jump at each revolution, and a swaying motion to the belt. Two of the arms were broken close to the hub, and the rim had sprung away fully 3-16th of an inch.

As I write this I can see sweat on the suction pipe of a boiler feed pump; that is not right, for the water in the tank is, or should be, over 100°. I will investigate. Tom, the piper, had opened a valve leading to the tank, in order to draw the water out of the main pipes while making repairs, and he had forgotten to close it again when he turned the water on.

As you watch the movement of the cut-off gear, and see a regular swaying motion to it that does not coincide with any visible cause, and which seems to move in about one, two, three, four and repeat time, you may know that the engine is not taking steam evenly on both ends, and that, while the number of revolutions in any one minute may not vary, you will find that the time taken for revolutions one and four vary considerably.

I do not under-estimate the sensitiveness of regulator apparatus to changes in the load of an engine, but if the successive strokes show several parallel lines on an indicator diagram when the pencil is allowed to remain pressed against the paper, it is usually pretty good evidence that the steam is unevenly admitted on the two ends. Especially is this true if the diagrams always show this peculiarity. This intermittent motion is not only disagreeable, but entirely unnecessary, and can be corrected by patiently adjusting the valves according to the facts shown by the indicator when that instrument is properly applied, and its lines intelligently studied.

Above the dull grind of great gears, the hum of belts, the click of valves and the hissing of steam, the trained ear detects the thump or jar that denotes the improper admission or cushion of steam, or the looseness of some part—although the latter sounds would be entirely lost amid the greater roar to those unaccustomed to them. An unusual sound may be heard to keep time with the moving parts of an engine that the new beginner may mistake for a loose gib or crank-pin brass, while, in fact, it may be a slack or a broken follower bolt. These sounds may occur at the same part of the stroke from either cause, and sound the same to a novice, while to one who has "been there" there would be little resemblance.

The hand explores parts and passages hidden from view, and when directed by experience reveals the conditions as accurately as could be conveyed by any other of the senses. Few realize the wonderful accuracy of touch the hand may become educated to. It becomes unconsciously cunning in handling machinery day after day, yet it is by no means sure that an engineer who can handle his own engine with skill could operate some other kind, even with safety, until he has become acquainted with it. If any of my engineering friends doubt this, and wish to lose their conceit, let them get some marine or railroad engineer friend to allow them to try the starting bar of a ferryboat, or to stop a locomotive within ten feet of a given mark, or any of the men who so skillfully operate these engines to easily stop or start a large stationary engine with disengaging valve gear. Each will find that he has not the proper touch, although experience with any engine is valuable in acquiring skill with any other.

One of the most valuable features of the sense of touch is that something that tells a man just how hard to pull, and just when to stop, when operating that useful but abused implement, the monkey-wrench. Bitter experience has taught me that there is just cause for alarm when a man that has not the "touch" approaches an engine armed with one of these weapons, for after some men have broken or stripped a few nuts and bolts they lose their courage, and are quite likely to come as far short of applying the proper strain as they formerly went too far.

The sense of smell detects escaping gases from a defective flue or boiler setting, or the sulphurous fumes that show heating and danger of spontaneous combustion in large masses of soft coal, and a hot bearing gives an odor that will never be mistaken for the fragrance of one of the cigars the oil agent insisted on your taking when he sold you the lubricant that has got the bearing and yourself into trouble. The smell from different kinds of lubricants is entirely different to those used to them, and the quality and ingredients of many engine-room supplies can be quite correctly judged by their distinctive and unmistakable odors.

Engineers are not recommended to imbibe very freely from bottles of any kind, and the sample vials the oil agent has are not a pleasing source of sustenance in any case, but a drop from one of them transferred by a toothpick to the tongue may reveal the presence of acids that render the oil undesirable for use in some places around the plant. Here the final sense of taste is brought into requisition to aid the engineer to an intelligent discharge of his duties.

Water came into the basement of a building, and a 6" fire supply pipe that was laid under the floor was the suspected cause. The engineer, however, tasted of the water and found it was salt, and from that hint it was found that the tide came in around the pipe instead of fresh water through it. Another basement was daily flooded with tide water, and the engineer rigged up a steam jet with pipe fittings to throw it out, and he noticed that the water that came in when this was working was slightly warmer than at other times, and he reasoned that the leak into the basement must be very near to the sewer pipe he forced this water out through. Further investigations showed that a sand hole in the cast-iron pipe, about a foot outside the foundations, was the whole cause of the trouble. This was reamed out, tapped and plugged at a very trifling expense, and in view of the fact that a contract had about been entered into for sheet piling the entire building at an expense of $4,000, it will be seen that the exercise of this man's senses was of considerable value to the proprietors of the building.

It will be seen how important it is for the person in charge of steam apparatus to have all his wits about him, and to have all his senses trained to correctly convey to his mind the actual conditions of things as revealed by the sensations of sight, of sound, of the touch, of the odor or the taste, and it is only by the exercise of all the faculties that we may secure success.

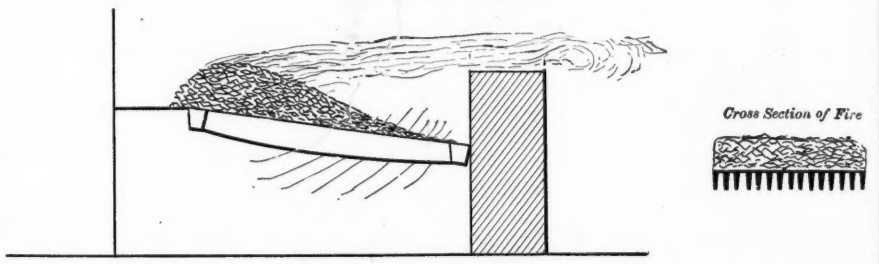


Fig. 1

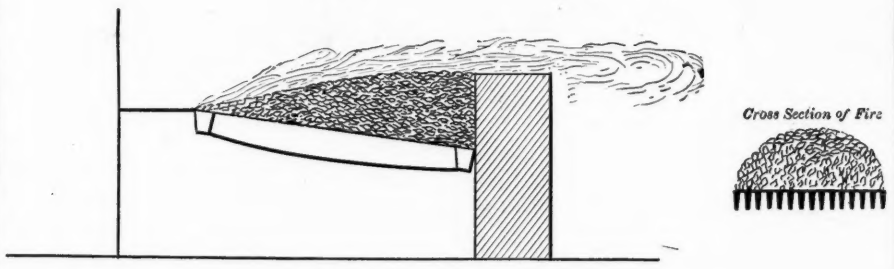


Fig. 2

CHIMNEY SUCTION.—SEE PAGE 2.

Just why American manufacturers will sell machinery and other goods from ten to thirty per cent. cheaper in Europe than they will sell them to be used at home is rather puzzling; but any one curious in the matter can easily enough find out that many of them do this. It may be necessary to cut prices in order to secure trade from abroad, but it is likely to strike the American purchaser as being a little rough on him.

Practical Drawing.

BY J. G. A. MEYER.

EIGHTY-SIXTH PAPER.

Problem 97.

622. *Intersection of a prism with a pyramid.*

Let $a\ a_3\ c\ c_3$ in Fig. 506*a* be the vertical, and $a_2\ b_2\ c_2\ d_2$ in Fig. 506 the horizontal projection of a prism with a square base; also let $e\ h\ f$ be the vertical, and $g_2\ j_2\ f_2$ the horizontal projection of a right pyramid with a hexagonal base; the pyramid being passed through the prism as shown. It is required to find the projections of the lines in Fig 506*a* in which the pyramid intersects the faces of the prism; or, in other words, it is required to find the lines $n\ r$, $r\ n_3$, $w\ t$ and $t\ w_3$.

Through the point n_2 (Fig. 506) draw a vertical line cutting the line $h\ f$ (Fig 506*a*) in the point n_3, also cutting the line $e\ f$ in the point n; again, through the point r_2 (Fig. 506) draw a vertical line cutting $g\ f$ (Fig. 506*a*) in the point r. Join the points n and r, also r and n_3 by straight lines; these lines will represent the intersections of the pyramid with the face $a\ b\ a_3\ b_3$ of the prism. The pyramid will also cut the same face of the prism in the lines $a_5\ n$ and $a_7\ n_3$. The line $a_5\ n$ appears to be a part of the edge $e\ f$; the reason for this is that the line $a_5\ n$ and the edge $e\ f$ lie in the same plane, which is perpendicular to the vertical plane of projection. Similar remarks apply to the line $a_7\ n_3$, and the edge $h\ f$.

Through the point t_2 (Fig. 506) draw a vertical line cutting the line $g\ f$ (Fig. 506*a*) in the point t; also through the point w_2 (Fig. 506) draw a vertical line cutting the line $h\ f$ (Fig. 506*a*) in the point w_3, and also cutting the line $e\ f$ in the point w. Join points w and t, also t and w_3 by straight lines; these lines, and the lines $w\ c_5$ and $w_3\ c_7$ will represent the lines of intersection of the pyramid with the face $b\ c\ b_3\ c_3$ of the prism. The intersections of the pyramid with the faces of prism hidden by the faces $a\ b\ a_3\ b_3$ and $b\ c\ b_3\ c_3$ coincide with the lines of intersections just found.

623. Fig. 506*b* represents another projection of the prism. In this figure the pyramid has been removed, thereby enabling us to see the opening made in the prism, the axis of the opening being perpendicular to the vertical plane of projection. The manner of finding the projection of this opening is similar to the method of finding the projections of the openings in Figs. 503*b* and 505*b*. Hence all that need to be said is that the horizontal distance between the points p_6 and n_6, also that between the points p_8 and n_8 (Fig. 506*b*) must be equal to the line $p_2\ n_2$ in Fig. 506; again, the vertical distance between the points p_6 and p_8, also that between the points n_6 and n_8 must be equal to that between the points n and n_3 in Fig. 506*a*; and the distance between a_{10} and a_{12} must be equal to that between the points a_5 and a_7. Once more, the horizontal distance between x_6 and w_6, also that between x_8 w_8 (Fig. 506*b*) must be equal to that between x_2 and w_2 in Fig. 506; and $u_6\ t_6$ equal to $u_2\ t_2$. The vertical distance between x_6 and x_8, also that between w_6 and w_8 must be equal to the distance $w\ w_3$ in Fig. 506*a*, and, lastly, $c_6\ c_8$ must be equal to $c_5\ c_7$.

Directions.—Prepare a sheet of drawing paper as before, and mark the spaces, Probs. 97, 98, etc. In the space marked Prob. 97 draw the vertical and horizontal projections of a prism and pyramid, the latter being passed through the former, as shown in Figs. 506 and 506*a*. Height of the prism, 9 inches; bases, 5 inches square; altitude of the pyramid, 10 inches; hexagonal base, 8 inches across the sides; the vertex of the pyramid is to project 1¾ inches beyond the edge $c\ c_3$ (Fig. 506*a*) of the prism. Find the vertical projections of the lines in which the faces of the pyramid intersect the faces of the prism. Also find another vertical projection of prism as shown in Fig. 506*b*. All these projections to be in the space marked Prob. 97. Use 3-inch scale.

Problem 98.

624. *To find the development of the lateral surface of the pyramid whose vertical and horizontal projections are given in Figs.* 506*a and* 506*; it is also required to find on this development those portions of the surface which lie outside of the prism.*

First find the development of the lateral surface of the pyramid in a manner as explained in Prob. 86, thereby obtaining an outline as shown in Fig. 507, in which the lines $f_0\ g_0$, $f_0\ e_0$, $f_0\ i_0$, $f_0\ j_0$, $f_0\ k_1$, $f_0\ h_1$ and $f_0\ G_1$ are equal to $f_2\ g_2$ in Fig. 506; and

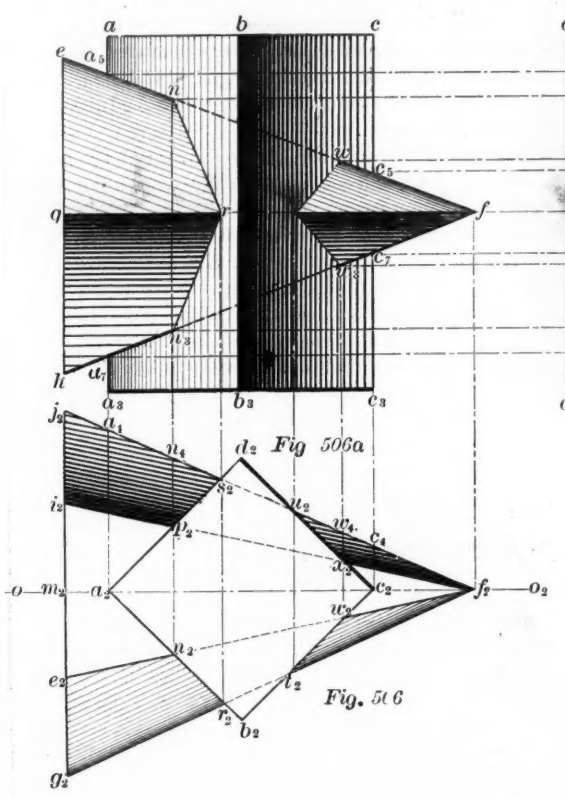


Fig. 506a

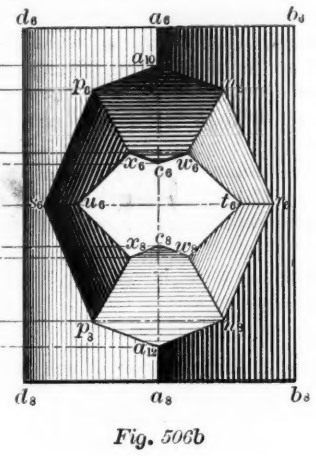


Fig. 506b

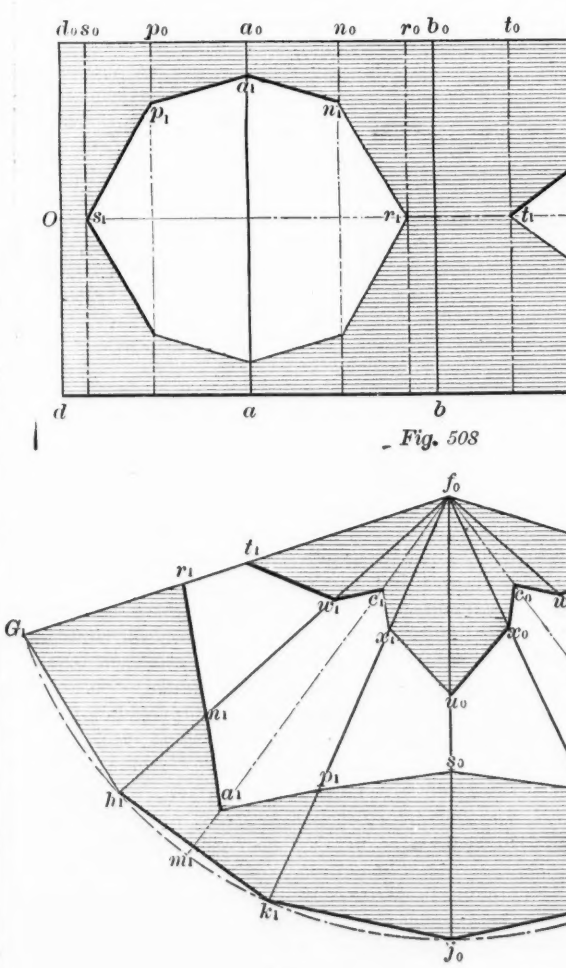


Fig. 508

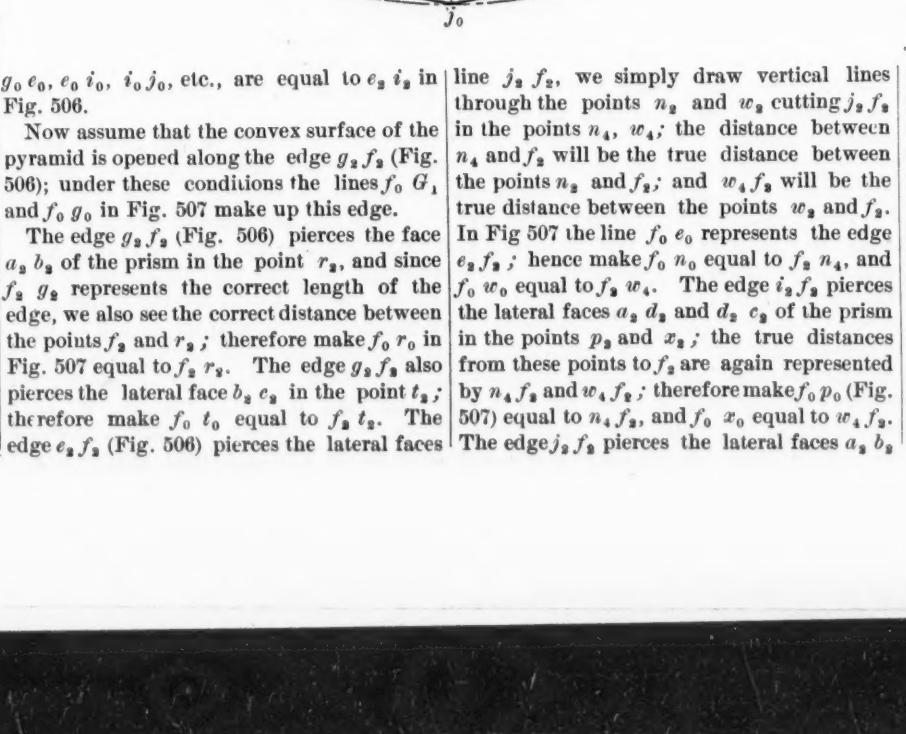


Fig. 507

$a_2\ b_2$ and $b_2\ c_2$ of the prism in the points n_2 and w_2; but since $e_2\ f_2$ does not show the correct length of the edge, we do not see on the line $e_2\ f_2$ the correct distance between the points n_2 and f_2, or that between the points w_2 and f_2. Now to obtain the correct distance between the points n_2 and f_2, or w_2 and f_2, we must measure these distances on lines $g_2 f_2$ or $j_2 f_2$, because either one of these lines shows the correct length of all the edges; for the sake of convenience we will measure these distances on the line $j_2\ f_2$. Now to locate the points n_2 and w_2 on the line $j_2\ f_2$, we simply draw vertical lines through the points n_2 and w_2 cutting $j_2 f_2$ in the points n_4, w_4; the distance between n_4 and f_2 will be the true distance between the points n_2 and f_2; and $w_4 f_2$ will be the true distance between the points w_2 and f_2. In Fig 507 the line $f_0\ e_0$ represents the edge $e_2 f_2$; hence make $f_0\ n_0$ equal to $f_2\ n_4$, and $f_0\ w_0$ equal to $f_2\ w_4$. The edge $i_2 f_2$ pierces the lateral faces $a_2\ d_2$ and $d_2\ c_2$ of the prism in the points p_2 and x_2; the true distances from these points to f_2 are again represented by $n_4 f_2$ and $w_4 f_2$; therefore make $f_0\ p_0$ (Fig. 507) equal to $n_4 f_2$, and $f_0\ x_0$ equal to $w_4 f_2$. The edge $j_2 f_2$ pierces the lateral faces $a_2\ b_2$ and $d_2\ c_2$ in the points s_2 and u_2; therefore make $f_0\ s_0$ equal to $s_2\ f_2$, and $f_0\ u_0$ equal to $u_2\ f_2$. It will readily be perceived that $f_0\ u_0$ will be equal to $f_0\ t_0$, and $f_0\ s_0$ equal to $f_0\ r_0$.

Now notice that the lateral face $i_2\ e_2\ f_2$ of the pyramid (Fig. 506) cuts two of the edges of the prism in points represented by a_2 and c_2, and these points lie in a line $m_2 f_2$ drawn through the center of the face $i_2\ e_2\ f_2$. In Fig. 506*a* the line $e\ f$ not only represents an edge of the pyramid, but it is also the vertical projection of the line drawn through the center of the lateral face of the pyramid; hence we may say that $e\ f$ is the vertical projection, and $m_2 f_2$ the horizontal projection of a line drawn through the center of the lateral face ($i_2\ e_2\ f_2$, $e f$). Now because $m_2 f_2$ is a horizontal line, we know that it is parallel to the vertical plane of projection, and because its vertical projection $e\ f$ in Fig. 506*a* is an oblique line, we know that it is inclined to the horizontal plane of projection, consequently $m_2 f_2$ does not show the true length of the line drawn through the center of lateral face $i_2\ e_2 f_2$; but its true length is represented by the line $e\ f$. Therefore if we wish to measure the distance from f_2 to any point on the line $m_2 f_2$ we must measure it in the line $e\ f$. Now the points in which the line $m_2 f_2$ pierces the two edges of the prism must be laid off in Fig. 507. In this figure the triangle $i_0\ e_0\ f_0$ represents the lateral face $i_2\ e_2 f_2$ of the pyramid; therefore draw the line $f_0\ m_0$ (Fig. 507) bisecting the triangle $i_0\ e_0\ f_0$, and on this line lay off the points a_0 and c_0, making $f_0\ a_0$ equal to $f\ a_5$ (Fig. 506*a*), and $f_0\ c_0$ equal to $f\ c_5$. Join the points t_0, w_0; w_0, c_0; c_0, x_0; x_0, u_0; also r_0, n_0; n_0, a_0; a_0, p_0; and p_0, s_0 by straight lines, and thus complete the development on the right of $f_0\ j_0$. The development on the left of $f_0\ j_0$ is an exact duplicate of the one just completed. The shaded portions of the development (Fig. 507) represent those portions of the lateral surface of the pyramid which lie outside of the prism.

Directions.—In the space marked Prob. 98 find the development of the lateral surface of a pyramid. The dimensions of the pyramid and prism, and their relative positions, are the same as those given in the directions at the end of the previous problem. Use 3-inch scale.

Problem 99.

625. *Development of the lateral surface of a prism.*

It will be profitable and interesting to the student to find the development of the lateral surface of the prism—shown in Fig. 506*a*—in which the openings made by the pyramid are also worked out. This development is shown in Fig. 508.

The manner of finding the development of the lateral surface of a prism we have explained in Art. 426; hence all that need to be said here is that the rectangle $d_0\ D_0\ d\ D$ (Fig. 508) represents the development of the lateral surface of the prism; its length $d\ D$ must be equal to four times the width ($a_2\ b_2$ or $b_2\ c_2$, etc., Fig. 506) of one of the lateral faces of the prism, and the width $d\ d_0$ of the rectangle must be equal to the height $a\ a_3$ (Fig. 506*a*) of the prism.

The lines $a_0\ a$, $b_0\ b$, $c_0\ c$ drawn through the points a_0, b_0, c_0, which divide the line $d_0\ D_0$ into four equal parts, separate the rectangle $d_0\ D_0\ d\ D$ into four equal surfaces, each one being equal to a lateral face of the prism. Assuming now that the lateral surface of the prism is cut along the edge, which is represented in Fig. 506 by the point d_2, then the surface $d_0\ a_0\ d\ a$, in Fig. 508, will represent the lateral surface of the prism, which, in Fig. 506, is represented by the line $a_2\ d_2$; and $a_0\ b_0\ a\ b$ will represent another lateral face, which, in Fig. 506, is represented by the line $a_2\ b_2$. In a similar way $b_0\ c_0\ b\ c$ and the line $b_2\ c_2$ represent the third lateral face, and $c_0\ D_0\ c\ d$ and the line $c_2\ d_2$ represent the fourth lateral face of the prism.

Now let us consider the manner of finding the opening made in the face $d_0\ a_0\ d\ a$.

According to the conditions given, $d_0\ a_0\ d\ a$ is represented in Fig. 506 by the line $a_2\ d_2$; the lateral face of the prism, which is represented by the line $a_2\ d_2$, is pierced by the

edges of the pyramid in the points s_2, p_2. Therefore, in Fig. 508, lay off on the line $d_0\ D_0$, the points s_0 and p_0 making $d_0\ s_0$ equal to $d_2\ s_2$ (Fig. 506), and $d_0\ p_0$ equal $d_2\ p_2$. Through the points s_0 and p_0 draw lines parallel to $d_0\ d$. On the line through s_0 lay off a point s_1, making $s_0\ s_1$ equal to the vertical distance from the point r to the line $a\ c$ in Fig. 506*a*. On the line through p_0 lay off a point p_1, making $p_0\ p_1$ equal to the vertical distance between the point n and the line $a\ c$; and lastly, on $a_0\ a$ lay off a point a_1, making $a_0\ a_1$ equal to $a\ a_5$ in Fig. 506*a*. Join the points s_1 and p_1, also p_1 and a_1, by straight lines, and through s_1 draw the line $o\ o_1$ parallel to $d_0\ D_0$. Now the lines $s_1\ p_1$, $p_1\ a_1$ represent the extent of the opening above the center line $o\ o_1$; the opening below the center line $o\ o_1$ will be an exact duplicate of that above it. It must also be obvious that the opening in the face $a_0\ b_0\ a\ b$ is an exact duplicate of the opening in the face $d_0\ a_0\ d\ a$.

Now let us consider the manner of finding the opening in the face $b_0\ c_0\ b\ c$. This face is represented in Fig. 506 by the line $b_2\ c_2$, and it will be noticed that the lateral edges of the pyramid pierce the face $b_2\ c_2$ in the points t_2 and w_2.

On the line $d_0\ D_0$ lay off from b_0 two points t_0 and w_0, making $b_0\ t_0$ equal to $b_2\ t_2$, and $b_0\ w_0$ equal $b_2\ w_2$. Through t_0 draw a line parallel to $b_0\ b$, cutting $o\ o_1$ in the point t_1; also through w_0 draw another line parallel to $b_0\ b$, and on it lay off a point w_1, making $w_0\ w_1$ equal to the vertical distance between the point w and the line $a\ c$, in Fig. 506*a*. Lastly, make $c_0\ c_1$ equal to $c\ c_5$ (Fig. 506*a*). Join the points c_1 and w_1; w_1 and t_1 by straight lines, which show the limit of the opening above the line $o\ o_1$; the opening below the line $o\ o_1$ is a duplicate of the one above. The opening in the face $c_0\ D_0\ c\ D$ is a duplicate of the opening in the face $b_0\ c_0\ b\ c$.

626. The lines $s_1\ p_1$, $p_1\ a_1$, etc., and also the lines $t_1\ w_1$ and $w_1\ c_1$, etc., in Fig. 508, which make up the boundary lines of the openings in the development, are the lines in which the faces of the pyramid cut the faces of the prism; and the lines $r_0\ n_0$, $n_0\ a_0$, etc., and the $t_0\ w_0$, $w_0\ c_0$, etc., in Fig. 507, which make up the boundary line of that portion of the lateral surface of the pyramid which lies inside of the prism, are the lines in which the faces of prism cut the faces of the pyramid. Consequently, if the constructions in Figs. 507 and 508 have been correctly made, the line $r_1 n_1$, in Fig. 508, will be equal to $r_0\ n_0$ in Fig. 507; $n_1\ a_1 = n_0\ a_0$, $a_1\ p_1 = a_0\ p_0$ and $p_1\ s_1$ equal to $p_0\ s_0$. If these conditions do not exist, then there is a mistake somewhere which must be rectified.

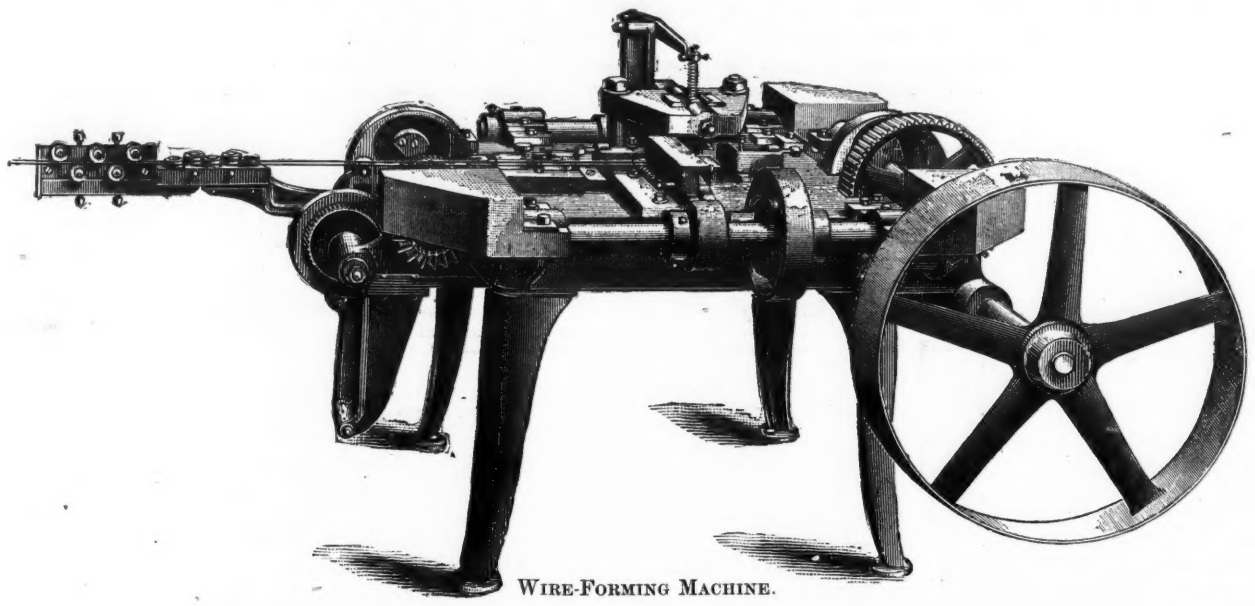
Directions.—In the space marked Prob. 99, find the development of the lateral surface of the prism, the dimensions of the prism and pyramid wich is passed through the former are the same as given in the directions at the end of Problem 97. Use 3-inch scale.

A Rochester dispatch dated Sept. 18 says: Engineer J. E. McGregor left Canandaigua for Rochester on the Central last night, with twelve freight cars, on wildcat time. As he left he said to his fireman: "I'll make East Rochester before No. 12 or bust." At Brighton he found the main line semaphore against him and whistled for down brakes; but he was too late, and his train dashed on to a dead track and into two freight cars, knocking them eighty feet into a ditch and telescoping the engine. Fireman Van Ever jumped and escaped, but McGregor was missing after the crash. Early this morning his body was found under the engine, horribly mangled.

Improved Wire-Forming Machine.

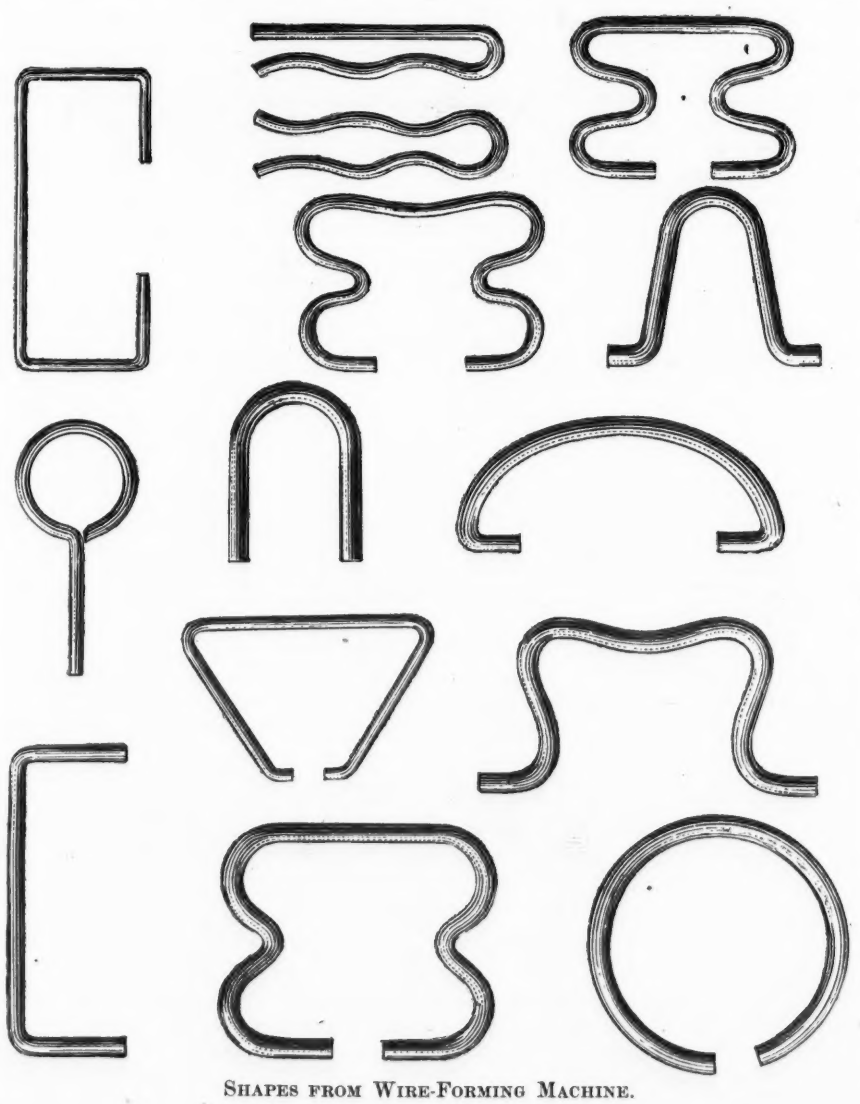
We present with this, engravings illustrating a four-slide machine for forming wire, and also some of the shapes into which wire may be formed by the machine.

This machine has four slides, actuated by cams placed upon shafts, one of which runs



WIRE-FORMING MACHINE.

along each side of the machine. These slides carry at their inner ends the various dies needed for forming the wire about the former, this former being itself movable, which is the distinctive feature of this machine, others having a fixed or stationary former, while in this machine it is mounted on a slide, which is carried over to a stop by the action of the first die coming against it, and held there until the other dies have completed their part of the work, and the finished piece has been stripped from the former, after which the former is returned to its original position by the action of a spring. The wire as it is fed into the machine passes between the former and the first die, and the required length is cut off, it having been previously gripped between the die and former. By the continued motion of the die the piece is carried over to one side, where the other dies act upon it in turn. This moving former has been found to be a great improvement over the fixed one, one of the principal reasons being that the piece is more securely held, and is not so liable to tilt out of its proper position in the groove of the die, and thus stop the action of the machine. Then, owing to the fact that the pieces of wire are, as soon as cut off, taken away from the cutting dies, any short piece cut off, from the imperfect action of the feed, does not interfere with the operation of the machine, and the only loss is the short piece cut off, and the time consumed by one stroke of the machine. With the stationary former, one of the difficulties has been that a short piece cut off would block the action of the machine. Another advantage gained is in the fact that with the sliding former the bending need not necessarily begin in the center of the piece, but it may receive its form at either end, or wherever it may prove most advantageous. Owing to the fact that the former is carried into direct line with the side dies, these are reduced to a more simple form, being simply straight tools without off sets or other irregular form, which not only add to the expense of making them, but, by causing a side strain, increase the friction of the machine, and consequently the power required to drive it, and the destructive wear; it having been found that a two-inch belt will drive a machine made in this way, which, if made with a fixed former, required a four-inch belt the machines being otherwise just the same.



SHAPES FROM WIRE-FORMING MACHINE.

The device for removing the article formed from the former, called the stripper, is another important feature in this machine, as it is carried forward and backward with the former, and is always in position to act promptly.

The operation of the machine in producing the different shapes of wire is as follows:

The wire passes first through the straightener, the feeding mechanism drawing through the predetermined length at each stroke. The first die is carried forward by the cam in front, and engages the wire, holding it securely but without pressure thereon, the wire lying in the groove of the die, and resting against the former. At this instant the cutter is carried forward by a cam, which is also on the shaft in front, and severs the piece of wire, and then returns to its place. The continued forward movement of the first die carries the sliding former forward until the limit of its movement is reached by contact with a stop bolt. The continued movement of the first die after the former ceases to move, bends the blank around the former, and shapes the first side of the article. While the first die remains in this position, the second and third dies, one on one side and the other at the opposite side of the machine, advance inward by the action of the cams on either side simultaneously, and form the second and third sides of the article. An instant later the fourth die moves forward by the action of the cam on the back side of the machine, and forms the fourth side of the article. This completes the forming. Then the dies open or retract simultaneously, the sliding former goes back to place, and the stripper acts to remove the completed article, which falls into a receptacle under the machine, the feeding mechanism acting to carry forward the wire to form another article as before.

Articles are formed in this machine at the rate of seventy-five per minute, and even at a higher rate of speed, depending somewhat upon the size and shape of the article being formed.

These improvements upon the machine are the invention of Mr. Frank B. Manville, superintendent of the machinery department of Blake & Johnson's establishment, Waterbury, Conn., where some of them have been built and are at work. They propose to build them for others requiring such machines, having patterns completed for three sizes, the largest of which will work wire one-quarter inch in diameter.

Unexplained Accidents.

At a recent meeting held at Peterborough, England, Mr. Clement E. Stretton, Consulting Engineer for the Associated Society of Locomotive Drivers and Firemen, under whose auspices the meeting was held, addressed the audience upon various subjects pertaining to railway matters, and upon the subject of unexplained accidents or derailments said:

"For some time past a discussion has taken place in railway circles, both in this country and America, with regard to cases in which vehicles or trains leave the rails from no apparent reason. Several theories have been brought forward in order to explain or to account for what are termed 'inexplicable derailments,' but it appears to me that such theories are perfectly unnecessary, and that they are built upon an unsound foundation. Are there really any such instances in practice? In my opinion, there are not, and certainly within the past twenty years I have not met with any such case. It is perfectly

certain that a train will not run off the line without sufficient cause, and it is equally certain that the cause can be ascertained upon full investigation.

"I have known cases which appeared very great 'puzzles' at the time, but which years after, when the truth was told, became perfectly clear. On one occasion, for instance, I knew of a case of a wheel dropping in between the rails in a manner which appeared like an 'inexplicable derailment', and so it remained for about six years, until the gauger privately informed me that 'he found three keys had worked out of the chairs, but that he put them in before any one examined the line.' In another case, many years after it occurred, I was told that a fish-plate had been taken off, and a train was allowed to pass over the line; after some vehicles left the rails, the fish-plate was instantly replaced.

"Instances have occurred, in which wheels have left the line in consequence of an axle running hot and the axle-box becoming fast; but, of course, by the time the official investigation took place the axle was quite cool again, and it was not even suspected. I could give many other cases of a similar character which have come to my own knowledge; but enough has been said to support my opinion that 'derailments' are only 'unexplained,' when the whole truth is not known."

LETTERS FROM PRACTICAL MEN.

A Small Cupola Wanted.

Editor American Machinist:

A few articles in your paper on iron melting and casting in very small quantities, would be of great value to many machinists, certainly to any that are situated as I am. When a machinist has a good foundry near at hand he has no need to bother with making his own castings, but when it is twenty miles, and four days' time, to a foundry, it is of importance to know how to rig up, and cast a hundred pounds.

Such a small outfit would save many a delay, and often help keep a customer who is in a hurry (and they are generally in that condition), while it would not interfere with the business, when time is of no importance.

I have searched the text books on the art, and find them devoted to thirty-six inch cupolas, and ten thousand pound charges, and written for those who are already in the business.

What is wanted is a plain description of the tools, appliances, and materials needed to melt and cast one hundred pounds of iron, to be written with the understanding that the reader never saw the inside of a foundry.

If you could induce some of your many able correspondents in the founding business to lower their vision for a while, and deal with such a small matter, you would confer a benefit on many. GEORGE B. GRANT.

[If our correspondent will look at the AMERICAN MACHINIST of Jan. 19 and Dec. 13, 1884; May 16, 1885; Feb. 12, 1887, and March 17, 1888, he will, we think, find what he wants. We shall, however, from time to time, publish more on the same subject when we find anything that gives additional information.]

"A Bad Practice."

Editor American Machinist:

In your issue of Sept. 12th is an article relating to societies sending tickets to manufacturers soliciting aid, either money or books. Your remarks were right to the point, and it seems hardly credible that men should so far forget themselves as to offer to sell themselves so cheap. Still there are manufacturers who do not wait to be asked for favors of that kind, but who send out all kinds of offers to engineers' societies, if they will only recommend their particular line of goods.

There are a great many engineers who are not in the market for that class of business, and one society had been bothered so much with that kind of offers that they passed a vote that anything of that kind received by the secretary, all circulars, and everything coming with it, should be immediately returned by express C. O. D. They are not troubled with that kind of correspondence any more. They are glad to place any article sent them on exhibition in their rooms, with the understanding that the articles must rest entirely on their merits. Such a course followed out by all societies would result in the greatest good and the highest self-respect to all concerned. W. E. CRANE.

Counterbores.

Editor American Machinist:

The Brown & Sharpe Manufacturing Company have in use in their works a counterbore similar to the one illustrated in your issue of September 12th, 1889, with this difference: The tits have a taper shank, and are all made standard so they will fit any counterbore of this class. The writer's experience in connection with the tool-room for a number of years confirms the belief that this is an economical way of making counterbores of the larger sizes, as well as sizes that are not in general use, but are liable to be called for at any time, and generally with a size tit that is not on hand; it was this fact which led to the adoption of this style of counterbore. The advantage of the taper over the straight shank is obvious, as the counterbore can be ground true by the taper hole, then the tit being driven in, the tool will run as true as if made solid, which cannot be claimed for one with a straight shank tit, held by a set screw on one side. I write thus not in a spirit of criticism, but simply to give to others the benefit of several years' experience in the tool-room of a firm whose practice—if not motto—is *help your neighbor.*

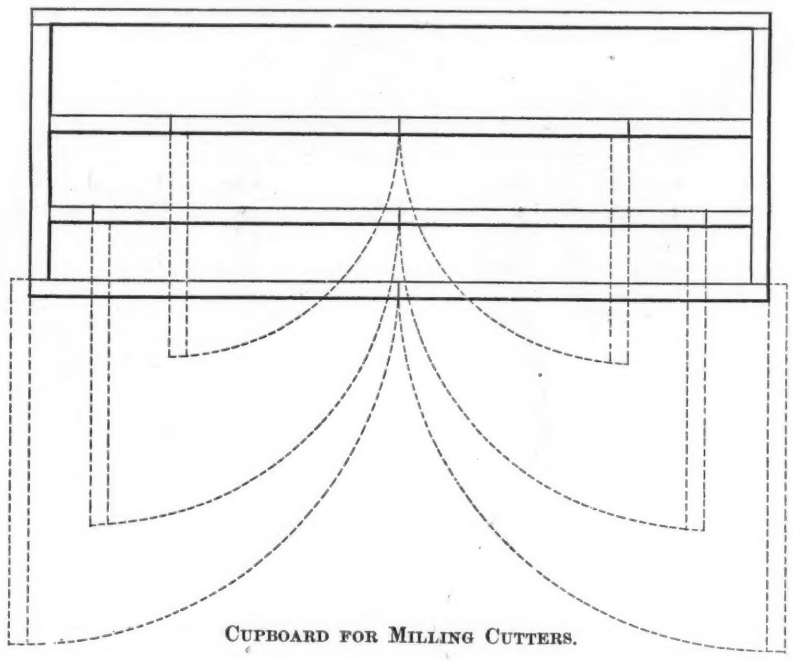
TOOL-ROOM.

A Washington correspondent of the *Cleveland Leader* evolves the conclusion that, in shrinking the bands on large guns, if one of the bands were to stick, before reaching its place, "it would then have to be cut off, and the whole gun made anew." There is nothing like the average daily newspaper man to get at the mechanics of a thing.

The autumn term for the classes of the Young Men's Institute begins Monday, September 30. Drawing and steam engineering, amongst other things, are taught, the cost to the student being merely nominal. An invitation is extended to all young men. The rooms of the Institute are 222 and 224 Bowery, New York.

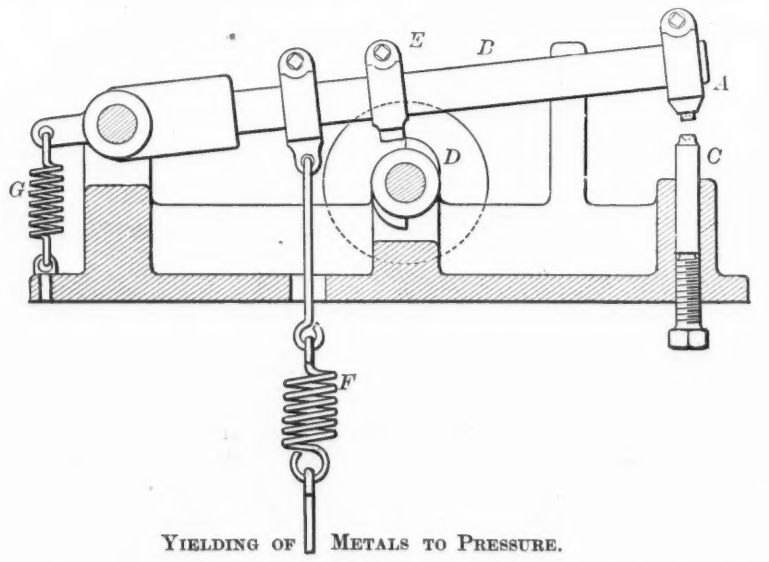
A Cupboard for Milling Cutters.

In some shops where milling machines are used, the matter of providing a suitable place in which to keep cutters when not in use never becomes a very serious problem, either because the kind of work done upon the machines does not call for the use of many cutters, or because of a lack of appreciation of the necessity for a full line of cutters to make the machine fully efficient. Where a universal milling machine is used on tool work, a very large number of cutters is required if the machine is used to anything like its full capacity, and then the matter of providing a place in which to keep them, that is entirely satisfactory, becomes a problem which in many shops is not so far satisfactorily solved. The ideal arrangement would seem to be to so fix things that any cutter can be immediately found when wanted, and, when found, taken from its place, without the necessity for handling any cutter but the one wanted. Finally, in most tool rooms it is important that as little space be taken up by them as possible. On this page is a diagram, showing the arrangement of a cupboard devised by Mr. Brady, of the Brady Mfg. Co., Brooklyn, N. Y., and in use in the tool room there. It is an ordinary cupboard, only that instead of one pair of doors its has three pairs. Brass studs are driven into both sides of all these doors, upon which the cutters are hung, the studs being turned up at the outer ends to prevent the cutters being thrown off by the swinging of the doors. It will be noticed that the outside doors are hinged as far out toward the side of the cupboard as possible, and that each succeeding pair are hinged further in towards the center, so that when all the doors are open they do not interfere with each other, and there is still space between them for the cutters. The position of the doors when closed is shown by the full lines, and the position when open by the dotted lines. Not only the doors, but the back of the cupboard and some of the spaces at the sides can also be utilized, and it will be seen that no space is wasted, nor is it necessary to remove a lot of cutters in order to get at the one wanted. No sizes are given on our sketch, because the dimensions will of course be varied to suit the circumstances. It would probably not be best to provide for hanging up cutters exceeding one inch in thickness, as those of greater thickness than this will be comparatively few, and can be laid in the bottom of the cupboard or provided for elsewhere. This would call for a space of about five inches between the doors when closed, and the total depth of the cupboard will not be quite 20 inches.



CUPBOARD FOR MILLING CUTTERS.

If it is made four feet wide and five feet high there will be room for hanging up about two thousand cutters of ordinary sizes, without having more than one cutter on any hook, though, of course, some of the smaller ones, and those used together, would be preferably hung up together. Another advantage of this plan is the fact that cutters do not injure each other by being thrown together. Of course the doors and hinges must be quite strong to support the weight, and suitable stops should be put in at the top or bottom, or both, to prevent the doors striking together when opening or closing them.



YIELDING OF METALS TO PRESSURE.

Some Uses of the Yielding of Metals to Pressure.

BY JARNO.

THIRD PAPER.

The particular manner in which a piece of metal yields to a blow depends upon the hardness, the weight and the speed of the thing with which the blow is struck. A machinist straightens a shaft by striking the high side with a heavy, soft hammer; he straightens the same shaft by striking the low side with a light, hard hammer. The heavy, soft hammer acts more as a slowly applied pressure, or like a screw press, and takes out a bend by bending in the opposite direction. The light, hard hammer dents, or penes, and in consequence lengthens the low or short side, which straightens the shaft. Now a shaft can be straightened with a heavy, hard hammer, if it be heavy enough to bend the shaft more in the direction that it strikes than it tends to pene the shaft in the opposite direction. For any given shaft there is a size of hard hammer that will pene in one direction as fast as it will straighten in the other, and, without a change in tendency, a man may hammer the shaft and his lifetime away and accomplish nothing.

The figure is a representation of a riveting machine, the sketch and description of which were kindly given to me by the inventor, Mr. C. H. Norton. He says that hammer riveting is merely a series of dents. The particular manner in which pieces are riveted depends upon the weight or pressure, and the speed of the thing that does the riveting. Before the machines were made, hand hammers were used which were often more effective than the operatives were efficient. When told by Mr. Norton, the story of the rivetings and doings of these hammers in the hands of unskilled and changeful operatives, sounds like a romance, interesting, though discouraging: that of the riveting machine is a story running through an occasional hour from among the busy hours of two years and ending in hopes realized.

The pieces that Mr. Norton riveted one to another were of sheet-brass about one thirty-second inch in thickness. The rivets were from one-sixteenth to one-eighth inch in diameter and about three thirty-seconds inch long under the head. They were made from brass wire, were generally harder than the sheet-brass, which, in consequence, gave them but little support when being headed. Two blows of a four-ounce hammer would shorten a rivet so that it would be nearly or quite even with the piece that it was supposed to hold, but it would not be right, because its body would be enlarged the whole length and be only slightly tapering, a little larger at the end, but not enough larger to hold. He tried lighter hammers, weighing about one and a half ounces each, which

formed heads on rivets of some sizes without enlarging the bodies, but these hammers were still too heavy for the smallest rivets. Some of the one-and-a-half-ounce hammers were cut off at each end, leaving them one ounce, which proved to be light enough; but the operatives did not like to have them so light, because so many blows had to be struck to form a rivet head. When Mr. Norton was not near, the heavier hammers would be used by some operatives and the riveting would be worthless. Such stimulants to morality as are kept in workshops for cases in which a lack affects the employer, were administered. Reward was offered to informers, discharge was threatened to bad riveters. Another trouble came not so much through lack of morality as through lack of skill. Among the pieces to be riveted one to another were many eccentric washers, called glass-clamps, for holding glass plates, the edges of which were placed under the clamps while riveting. A wild blow, uneven hammering, or two much hammering, would break a plate.

The riveting machines afforded relief from all these troubles so far as the employer thought that his interest was concerned, though they did not, essentially, advance the operatives either in skill or in morals.

In following a description of the machines it may be interesting to remember a principle relating to moving bodies, which I copy from the text books. If two blows be struck with a hammer, and if its speed in the second is twice its speed in the first, then the work done by the second blow is four times that done by the first blow. This statement is derived from the principle that the work which a moving body can do varies as the square of its velocity. The same amount of work can be done with one blow of a one-ounce hammer moving at a certain speed, as can be done with a blow of a four-ounce hammer moving at half this speed, yet, though of the same amount, the work done by each hammer would not be in the same position. In order that it may do work, a hammer must meet with resistance or inertia; this may be otherwise stated by saying that it is the difference between the movements of the hammer and the thing that is struck which has to do with the work; a rivet that moves with the hammer will not be headed, while a rivet might be moved against a hammer and be headed with but little movement of the hammer. If the inertia of the rivet, or of that which it rests upon, is great compared to the work that the hammer can do, then the work done, or the yielding of the metal, will be near the place where the hammer strikes. A heavy pendulum may be moved by a slow push of the hand, but it may be dented and little moved by a quick blow of a hammer. The quicker the hammer strikes, the more resistance it meets.

It is not so easy to bring out a new machine as it is, when one has been brought out, to tell how it all happened. The telling is specially easy when to the explanation of the designer is added the authority of the text books.

In the figure, *A* is the hammer head; *B* is the helve; *C* is the anvil; *D* is a cam to lift the hammer; *E* is the helve lift against which the cam strikes; *F* is a spring to pull the hammer down; *G* is a spring to lift the hammer up. The spring *F* is attached to a treadle which the operative presses to bring the hammer down; it is this spring that makes the hammer strike—the hammer is only lifted by the cam. The spring *G* is only strong enough to raise the hammer when the foot is taken from the treadle, because all that this spring pulls, in lifting the hammer up, is taken from the efficiency of *F* to pull it down. The hammer and its helve weighs about a pound; the helve is about a foot in length; the spring *F* is of one-eighth inch wire and is about an inch outside diameter. The hammer strikes twenty blows a second. There is a die in the anvil and one in the hammer, each cupped to fit a rivet head.

When the foot is off the treadle, the hammer is stopped because the spring *G* does not let the helve lift *E* come down upon the cam *D*. A rivet is placed upon the anvil, the foot presses the treadle so that the spring *F* pulls down the hammer. There is a sound something like that of a large bee, and the rivet is headed.

Before a successful machine was made it was found that the helve must be neither too stiff nor too heavy, but that it must yield somewhat, when the cam strikes the lift. If the lift does not yield enough it will wear away the cam almost as quickly as if turned in a lathe. One cam was destroyed in less than ten minutes.

If the helve and the hammer are too heavy, and, in addition, the helve is too stiff, the hammer, by one stroke of the cam, will be thrown so high that it will not come down before the cam has made several turns. If the hammer is not light enough it will not answer to the spring *F* quick enough to strike a blow that will do the work. Mr. Norton learned the curious fact that, within certain limits, the lighter the hammer the more work it will do. It is the quick blow of the hammer pulled down by the spring that does the work; if the hammer be too heavy, its inertia will be too great to be overcome by the spring quick enough to do any work in the fortieth part of a second. It would appear that, though the hammer is heavier than a hand hammer for doing the same work, the blow is largely taken by the cam, and in consequence the work done upon the rivet is like that of a small hammer. A solid metal helve that was stiff enough was too heavy. A wooden helve worked well while it lasted, but it was soon splintered. The thing that finally answered every purpose was a piece of gas-pipe about seven-eighths inch diameter. The length of the stroke of the hammer is from one-eighth to one-quarter inch.

New Quick-Motion Vise.

As every mechanic is aware, the time and labor required for putting in and taking from the vise pieces of work of varying sizes is a considerable proportion of the total time and labor expended for most kinds of work, and numerous devices have been introduced for reducing it.

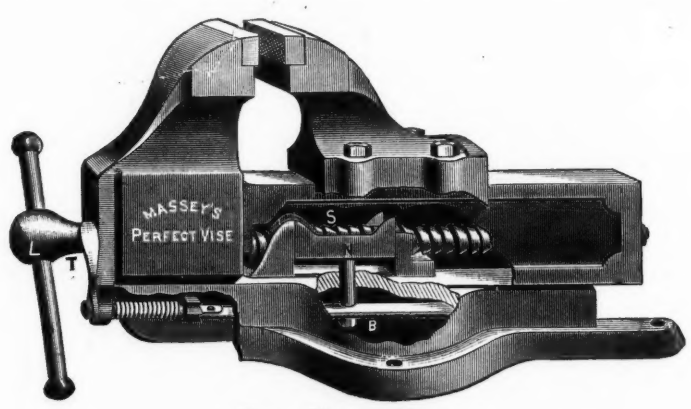
We present with this an engraving showing one of the latest of these.

In general appearance the vise resembles those in common use, but is provided with a screw having a buttress thread, and a nut which rises and falls for engagement or disengagement between two solid lugs, or housings. This movement of the nut is effected by means of a rod which passes longitudinally through the vise and is turned by means of the latch *T*.

In operation the work is held in position with one hand, while with the other the knob *L* and the latch *T* are both grasped, when, by pressing the latter against the knob, the screw and movable jaw can be moved in either direction and adjusted to the work.

The latch, upon being released, throws the nut into engagement, when a fraction of a turn secures the work. It is thus seen that the operation is performed without unnecessary movement and in the quickest possible time for a vise using a screw.

The entire screw with the knob is made of one piece of steel, and the vise is adapted for the heaviest clipping or other hard work, and has given the best of satisfaction in every-day use. The nuts are in the different sizes, from 2½″ to 4″ long. The vise is manufactured by Thomas C. Massey, 11 to 23 South Jefferson Street, Chicago, Ills.



QUICK-MOTION VISE.

Two men at Ticonderoga tied a rope around the feet of a fellow workman, who had fallen asleep, and threw the rope over a shaft, the object being to frighten him. The shaft, which was making 125 revolutions per minute, caught the rope, drew up the unfortunate subject of the "joke," and killed him. It wouldn't be right to hang men who indulge in jokes of this kind; their knowledge is not sufficient to render them responsible. But they ought to be carefully shut up for the term of their natural lives. It is said that one of the parties to the joke has lost his reason in consequence of the results, but most people will think neither of them had any reason to lose.

He came in boasting of the many beauties and advantages of his new slide-rule which a friend had sent him from England, and declared that any problem relating to engineering could be readily solved by it; and quickly too. To try him we asked: "By your slide-rule, what would be the proportion between two cylinders, one 12″, the other 16″ in diameter?" Pulling out the slide, reversing it, putting it in "t'other end to," and with a brave attempt to look mysteriously wise, he said: "In the proportion of the squares of 12 and 16," and we immediately conceded the great value of the slide-rule.

According to Minister Ryan, the people of the United States furnished Mexico with machinery valued at $462,384 in 1880, and $4,000,000 in 1887.

A Des Moines (Ia.) dispatch says: The story of an unknown tramp's heroism comes from Council Bluffs. He was walking on the Chicago & Northwestern track from Council Bluffs to Missouri Valley, and between Crescent and Stony Creek he found a broken rail on a high embankment where the rail makes a sharp curve. It was an outside rail next to the river, and no train could have passed over in safety. The next train due was the limited passenger, and he resolved to avert a terrible wreck if possible. He ran to Honey Creek, three miles, and tried to find the operator, who was not as his post. He then aroused the section hands, and they took the hand car and went back to the broken rail, arriving there just in time to flag the limited, and stop it within a few feet of almost certain destruction.

The fifty American workmen who constituted Scrips' league expedition have returned, and report having had a very interesting and enjoyable trip. They were in the main very well received at the foreign factories which they wished to inspect, and come home apparently congratulating themselves upon being citizens of America. Though they found some points in which English and Continental ways of doing things were superior to ours, the general opinion seems to be, among them, that in most things we are far in advance.

The price of iron and steel is steadily being raised in France, being but little lower than the price in the United States.

Those persons who are opposing the use of electricity for executions might, at first sight, be supposed to have received some support in their position from an address recently delivered before the British Association on the subject of electricity, by Mr. W. H. Preece, chief electrician of the Post-Office Department of Great Britain. Mr. Preece said that the electrical execution law of New York would have to be repealed, and claimed that it was impossible to get a current of sufficient intensity to kill a man with any certainty. He said that he had tried to kill a pig with a current of electricity, and had been unable to do so. He also said that the sensational reports in the newspapers about people being killed by shocks from electric wires had, upon investigation, been found to be nonsense. We sincerely hope that Mr. Preece knows far more about his duties as chief electrician of the British Post-Office Department than he does of what is going on in the world. And if he will only pay a visit to this country and go about a little amongst the electric appliances which we have here, we think he will never after that be heard to speak doubtfully of the capabilities of the mysterious fluid, if, indeed, he is ever heard to speak at all again in any manner or upon any subject. Our New York electric wires, not to speak of the equally efficient ones to be found in nearly every other American city, would make short work of any one who should go fooling around them with the confidence in their harmless nature which this British electrician would apparently have.

Vice-Consul Wopalenski has this to say about Russian petroleum: "About three hundred thousand cases of Russian petroleum from Batoum are expected—a quantity which will doubtless greatly influence the Java petroleum market, inasmuch as the monthly consumption of the whole island only amounts to about one hundred and sixty thousand cases. The contents of the case of both American and Russian petroleum is the same, two tins of ten gallons. Some of the above Russian petroleum has already been sold on delivery to retailers at 40 Java cents (about 16 American cents) per case, cheaper than the price at which American petroleum, imported in sailing vessels, can be bought. The rate to consumers will be eight cents a case less than American petroleum."

The drive wheel at the new iron works mill will be the largest of any in Fall River. It was cast at the Corliss machine shop at Providence, R. I., and is 28 feet in diameter. It has a face 114 inches wide, being the widest in the country, it is said.—*Boston Journal of Commerce.*

"It is said," as is sometimes the case, is mistaken. The fly-wheel pulley of the Watts-Campbell double engine, put in the Clark thread mills at East Newark, N. J., some six years since, has a face 114 inches in width, and drives with four belts.

The Washington *Star* says that people living along the line of the Chesapeake & Ohio Canal could buy coal for $2.50 per ton when the canal was in operation; now it comes by rail, and they pay $5. There is the same advance in all kinds of transportation rates. It is a wise plan to hold on to the canals.

A daily paper gives its readers the information that the volt bears the same relation to electricity, that "points pressure to the square inch does to steam." Now let it grapple with the question of what "points pressure" are.

The British Consul at St. Petersburg states that there is great competition there amongst German manufacturers of hardware, who are underselling each other, and have at the same time so lowered the standard of their goods that in many cases buyers prefer to pay dearer rates for English articles. The cheaper articles go largely to supply the Government contractors, and have been accepted for their low tenders. There is hardly any trade in locks from England, as these are made in Russia.

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NEW YORK, SEPTEMBER 26, 1889.

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The "Baltimore."

The recent performance of the new United States cruiser "Baltimore" afforded an excellent opportunity for the exercise of the talents of those people who are continually forming and announcing theories regarding something or another, and not always waiting to first be reasonably sure of their facts before announcing their theories. The "Baltimore" put to sea just at the beginning of the recent storm, and not being heard from for several days, it was not only concluded by these people that she had come to grief, but that her coming to grief had been the result of serious faults of design, which faults they did not hesitate to point out. They in effect declared that they had known all along that a vessel constructed in that way would be dangerous to those aboard of her in a high sea, and that it was really little short of suicide to venture out in her at such a time. But the "Baltimore," it seems, had no idea of sustaining the theories of these people, for she not only arrived safely at her destination, but, according to the report of her officers, behaved remarkably well, proving herself to be entirely seaworthy.

At the end of her stormy voyage the new cruiser underwent her official speed trial, in which she proved to be in every way entirely satisfactory. The results of the trial have not at this writing been officially announced, but enough is known to make it tolerably certain that a speed of nearly twenty knots an hour will be credited to her, and that the Cramps, who were her builders, will receive the very comfortable sum of $130,000 above the contract price, as a premium for the development of 1,300 horse power above the contract requirements; the stipulation being that the Government was to pay $100 for every horse-power developed above 9,000. The trial, which lasted four hours, seems to have been a very thorough one, and its result is very creditable to the builders of the vessel, going very far towards removing any lingering doubt there may have been in some quarters as to the ability of this country to turn out vessels of the highest excellence.

The Patent Sales Agency Business.

Those of our readers who have taken out patents within recent years know something of the extent to which inventors are besieged by various individuals and firms from Maine to the Pacific coast, who are anxious to negotiate the sale of patents, and whose circulars, letters and pamphlets, etc., are many of them skillfully designed to make the unhappy inventor, whose name and address has just appeared in the *Patent Office Gazette*, believe that there are plenty of people who are anxiously waiting for an opportunity to buy his patent and pay fabulous amounts for it, only these persons must be found.

The finding of them is what these patent salesmen propose to do. Their proposition is usually to take the patent in hand and find a purchaser for it, charging a percentage for their services. But the main feature of the business seems to be the fact that the inventor is always required to pay a certain amount of cash, varying with different concerns from five to twenty dollars, as his part of the expense of advertising, traveling, and correspondence, etc. It is perfectly safe to say that in a vast majority of cases this payment required of the inventor upon placing his patent in the agent's hands, pays not only a part, but all the expenses involved, and leaves a handsome profit to the agent; in most cases probably all the profit he seriously looks for from the transaction.

Sometimes, after a year or so has passed by, the anxious inventor, who has invested some of his cash in "advertising expenses," is informed that the arduous labors of the agent have at last resulted in the finding of a man who wants the right to make and sell the invention in several States, but can only pay for it in land upon which there is some sort of an incumbrance to the amount of say fifty to a hundred dollars, varying in different cases. If the inventor will forward the amount to the agent the sale will be immediately closed.

The significant feature of the whole business is the fact that the inventor is in every case required to pay something for which he has no assurance of a satisfactory return, and it is easy to see that with the vast number of patents being taken out, many of them by people more or less unused to the ways of the world, the income of these selling (?) agents must be considerable if they succeed in getting payments of small amounts from only a small fraction of the total number of patentees.

The recent arrest of the men composing a firm of these operators, located in California, and the trial which it is to be hoped will follow, may serve to better acquaint the people with the ways of doing business which these gentry have adopted, and in the meantime we advise such of our readers as have not yet learned to be cautious in such matters to investigate thoroughly before sending money to people whose only assurance of an honest return for it is given by glowing circulars. While it is no doubt true that some patents are disposed of in this way, it is also true that in a vast majority of cases no serious effort is made to sell them, the grand object of the whole business being attained when the inventor's share of the "expenses of printing and distributing circulars," etc., is received.

The dock laborers in London have gained an important victory in their great strike against their "masters," the dock companies. These companies had ground down the laborers to the lowest starvation point, and there is almost universal satisfaction over the fact that the men forced them to make some concessions. The men have, all the way through the struggle, conducted themselves in a way that we can hardly understand in this country. They have not created as much disturbance as would occur in a political campaign in a good sized village in the United States. The strike has brought out the fact that these dock laborers and their families have in part been supported by organized charity for years. This was in effect a contribution to the dock companies, which refused to pay living wages. It is a fact worth some thought.

The advent of the English compound locomotive in America has had the effect of stirring up considerable thought and some action in the matter. At least two locomotive works in the country are each building a compound for trial purposes. This is what is needed for a satisfactory comparison of compound with simple engines, as these engines will be of the American type, with the exception of being compound. Discussing the subject further is of little use; nothing but a fair trial can settle the question. If it is demonstrated that the compound locomotives will do the work with less fuel, and otherwise work satisfactorily, there are parts of the United States where the cost of coal would make their use a matter of a good deal of importance. Engineers will be strongly interested in an impartial trial of the two systems.

One of the latest things in trusts is the effort to combine the building and loan associations of Pennsylvania. The reason for the existence of such associations is that they help men o small means to own houses for themselves. Outside that, they are of little utility. If the building and loan associations in Pennsylvania, or elsewhere, go into a trust, it will be to the discomfiture of the investors of small means.

Literary Notes.

PRACTICAL IRON FOUNDING. By the author of "Pattern Making," Lockwood's "Dictionary of Mechanical Engineering Terms," etc.

This book will undoubtedly be appreciated by students and practical men. It gives a condensed account of the principles and practice of iron moulding in a clear and concise manner. It starts with describing the sands used, and then goes on in describing the flasks and tools required. Green and dry sand moulding is taken up, followed by chapters on loam work and machine moulding. In the appendix, sand mixtures are given, as typical and illustrative only of the manner in which moulding materials are prepared to suit the ever-varying requirements of the foundry. These tables of mixtures would be of greater value to students and beginners if the measure of the different sands had been given more definitely. The author does not pretend to give an exhaustive treatment of iron moulding, but simply gives a judicious condensation of the subject, making a perusal of this little book very interesting, and conveying much valuable information. We believe it is safe to say that those who have had limited experience in iron moulding will not regret the money spent for the book. It is published by D. Van Nostrand Company, 23 Murray street, New York. Price, $1.50.

GENERAL SPECIFICATIONS FOR HIGHWAY BRIDGES OF IRON AND STEEL. Second Edition. J. A. L. Waddell, Kansas City, Mo.

In the second edition of this book new matter has been added, considerably increasing the size. The book contains matter in relation to iron and steel bridges that is valuable to those interested. The specifications are quite complete, and, being written by a man practiced in bridge building, will be found valuable for reference. The book is in pamphlet form, contains sixty-four large pages, and can be had from the author for 25 cents.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(353) Monk, Chicago, Ill., writes: Please give me a receipt for making a metal that will expand instead of contracting when cooling; to be used in filling small holes in castings, etc.? *A.*—Lead, 9; antimony, 2; bismuth, 1 part.

(354) W. H. J., Worcester, Mass., writes: I would like to know what causes a draught in the chimney before the fires are started? *A.*—The draught in a chimney before fires are started is caused by the air having a higher temperature in the chimney than the outer air. If the air in the chimney has the same temperature as the outer air, there will be no draught before the fires are started.

(355) J. K., New York, writes: A friend of mine is going to build for me a model of a steam yacht—length 4 feet, breadth 12 inches. What size of engine and boiler will it require? Where can I buy them second-hand, and how much should they cost? *A.*—Cylinder about 1 inch diameter, 1½-inch stroke. We do not know where you can buy second-hand engines of this size; you may probably find new ones in any first-class mechanical toy store, where you may also obtain a boiler of suitable size. The cost will depend on the design of engine and the amount of labor expended on it.

(356) F. S. C., ———, asks: How is the mottled figure, such as you see on most gun-locks obtained in case-hardening, and does it add greatly to the cost over the common process? *A.*—It can be done by packing about the pieces to be case-hardened scraps of leather along with animal charcoal. Then things must be arranged so as to dump the contents of the boxes into water as they come from the furnace, without letting the air come into contact with the work. It requires skill and practice to produce the best results, and this, of course, involves some extra expense, though not necessarily very much.

(357) E. H., Joplin, Me., asks: What weight can I push with wrought-iron bar 2 inches diameter? I want to run a force and lift pump. *A.*—The weight will depend on the length of the rod. 2. If the bar is 100 feet long, with stay-boxes every 10 feet apart, how much can I push with the bar? *A.*—We believe that 10 feet between the boxes is too great a distance; 8 feet will give better results. Under these conditions, and the rod being used for a vertical pump, it will safely overcome a resistance of 8 tons at 2,000 pounds per ton. If the shaft works in a horizontal direction, the boxes should be placed still closer to each other, or other provisions made to prevent it from sagging.

(358) J. L. C., ———, writes: Please give me the rule for finding the diameter of worm gear blanks for V and square threads. I have had quite a number to make the past two years for new measuring machines which I have been designing, and think I have found a very simple rule for finding the diameter of very small worm gear

blanks. It is this: Divide the number of teeth you wish to have in the gear by 3, in every case adding one pitch of the worm to this. This gives the diameter of the blank in 10ths, 12ths, 16ths, or whatever the pitch of the worm may be. I take the pitch of the worm for the unit instead of one inch, as we do in spur gears. If the worm is 12 pitch, I have 3 teeth in the gear to every 12th in diameter; if 16 pitch, 3 teeth to every 16th in diameter on the pitch line, plus one in every case. The result in every case, large or small, fine or coarse thread, is a very handsome worm gear. Is the above right or not? *A.*—It is not strictly right, but is, for such work as you are doing, an approximation close enough to give good results. The correct way is to multiply the pitch of the teeth by the number of teeth wanted in the gear, and this product by .3183, the latter operation being equivalent to dividing by 3.1416. This gives the diameter at the pitch line.

(359) J. H. S., ———, writes: I wish to put in an upright shaft which will run at about 30 revolutions per minute, and carry a load of about 57,000 pounds. In such shafts I have had trouble in getting a step to stand the work satisfactorily, and have suggested putting in a ball bearing at the bottom, using hardened steel balls about 1 inch diameter, using about 18 or 20 balls. Some tell me that the balls will not stand the load. Can you give me any information on the subject? *A.*—A ball bearing can be made to stand the work, but a great many more balls than you mention will be required to bear such a load. Mr. John J. Grant, Manager of the Simonds Rolling Machine Works, advises the use of 207 balls ⅞ inch diameter, and arranged in concentric grooves.

(360) A. B., ———, writes: To settle a dispute, please answer the following: We had an engine to overhaul, and the man that got the piston to re-turn and the head to face up set his lathe to turn the rod straight, and turned it the same diameter from end to end. But when he came to take a cut down the side of the head (which was driven onto the rod, and running next the dead center), he found that it was hollow $\frac{1}{64}$ inch. The foreman told him to set the tail-stock over to make it face square. Now this man claims that by so doing it would not face it square, but would make it smaller towards the outside, and show the same amount of hollowness as before, and, besides that, it would not be square with the rod. He claims that the fault is with the cross-slide of the lathe being out of square with the shears. Now the question is, can a disk, or anything that is faced in that way, be faced hollow while driven on a mandrel, by moving the tail-stock one way or the other? *A.*—The trouble is probably, as the latheman says, caused by the cross-slide being out of square with the shears, and, under such circumstances, the only practical plan, short of remedying the fault in the lathe, is to set the tail stock over, when facing, until a square cut is taken. Such a question as this can be very quickly settled by a trial, which can be made in any machine shop in a very few minutes.

(361) R. A. Z., Tarborough, N. C., writes: Please name books treating on the marine engine, from which I can obtain sufficient knowledge to pass an examination for an engineer's license? *A.*—In the "Catechism of the Steam Engine," by John Bourne, you will undoubtedly find much valuable information; but besides this, you must have practical experience to enable you to obtain a license. In the general rules and regulations prescribed by the Board of Supervising Inspectors, we find the following: "No original license shall be issued to any person to act as engineer, except for special license on small pleasure steamers, who cannot read and write, or who has not served at least three years in the engineers' department of a steam vessel, or as a regular machinist in a machine works, provided that any person who has served for a period of three years as a locomotive or a stationary engineer may be licensed to act as engineer on steam vessels, after having had not less than one year's experience in the engineers' department of a steam vessel." 2. Also tell me about what kind of examination I will have to stand? *A.*—A fixed line of examination is not followed. If you have a fair common school education, and the practical experience required as stated above, and in the mean time studied books relating to the marine engine, you will not have any difficulty in passing any kind of an examination.

(362) X. Y. Z., ———, asks: 1. Can a highly tempered piece of steel of the shape shown be permanently magnetized? *A.*—Yes. 2. Will repeated blows on one end of a magnet destroy its mangetism? *A.*—Its magnetism can be decreased in that way, though we do not know that it can be entirely destroyed. 3. Which pays the greatest wages for the same grade of workmen—a railroad shop, a locomotive shop, a steam engine shop or a machine shop in which fine work is done? *A.*—Wages vary considerably in different parts of the country, and it is about impossible to say which class of shops pay, upon the whole, the best wages, and, any way, wages have a constant tendency to equalize themselves. If shops of a certain class pay better wages than others, mechanics are attracted to them in greater numbers, and wages are thereby depressed in the one or increased in the other, until things are about even again. The general scale of values and the necessary cost of living has a great influence on wages, and it is this chiefly which causes the wide difference in rates between different parts of the country. Generally speaking, however, the finer the work the higher the wages. 4. In which of the above mentioned shops are the chances of promotion best? *A.*—We cannot say. The chances of promotion usually depend upon the one who seeks promotion as much as the shop he is in. 5. Can a person learn to do as fine work in a railroad or engine shop as in others? *A.*—There are classes of work which require more accurate and more finely finished work than would be admissible upon locomotives or other engines, but excellent work is done in all the best shops. 6. Which is the best way to learn the management and maintenance of railroad machinery, to go into a shop first or on a locomotive as fireman? *A.*—The shop is the place to learn maintenance of machinery, though road experience is always useful. 8. Are the chances for securing a situation as apprentice as good if a written application is sent as if a personal one is made? *A.*—Usually a personal application is best.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p. 16.
Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.
Shafting Straighteners. J. H. Wells, Tampa, Fla.
Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.
"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.
The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.
R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.
The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.
Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton & Dutch sts., New York.
Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.
Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st N.Y.
Prestoline & Prestoline Paste, for cleaning & polishing metals. S. A. Smith, 23 S. Canal st., Chicago.
Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.
Long & Short Hob Taps, Stove Bolt & Bit Brace Taps. M'f'd by S. W. Card & Co., Mansfield, Mass.
Iron Planers from 16" to 36" wide by any length. H. C. Pease & Co., Worcester, Mass.
Patent Attorney. R. G. DuBois, 715 11th st., Wash., D. C., procures first-class patents for inventors.
For drawings or special designs communicate with Arthur L. Stevens, Mech. Eng., 11 S. 9th St., Phila.
Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Sept. 12, p. 13. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.
Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.
The best emery wheel made is the "Norwich." For particulars send to Montgomery & Co., 105 Fulton st., New York.
For the latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.
The hook on steam engines is being supplanted by the Dill disconnecting device made by the T. C. Dill Machine Company, 726 Girard ave., Phila., Pa.
Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.
W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.
25", 32", 37", 42" — "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.
Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages illustrated, 12mo., cloth, $2. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N.Y.
Wanted—Something else to manufacture. Prepared to buy out or make. Established with machinery and hardware trade throughout the country. Works at Philadelphia, Pa. Address Well-Equipped, care AMERICAN MACHINIST.
De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and Equipment well adapted for Heavy Steamship Repairs.
H. B. Roelker, 22 Cortlandt st., New York, late Sup't Delamater Iron Works, will hereafter manufacture the Delamater Screw Propeller.
Propellers of same pattern and workmanship as formerly made by the Delamater Iron Works. Each designed for its special work at lowest prices.
Consulting Expert and Constructing Engineer.
Estimates made on machinery and on damages.
25" back-geared; 28" power feed; 32" quick-return; 36" Upright Drills — Finely made, quickly operated, well designed and conceded by leading manufacturing firms to be the best. For sale by leading machinery dealers. Will send name of firms using my drills, also cuts and prices. J. E. Snyder, Worcester, Mass.
"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.
"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.
Patterson, Gottfried & Hunter (Lim.), 146-150 Centre St., N. Y., carry a complete stock of Brush Copper, Celluvert Fibre, Oiled Paper, Hard Rubber, Rod & Sheet Brass, Brass, Copper & Iron Wire, Self-Hardening Tool Steel, Set & Cap Screws, Machine Bolts, Machine & Wood Screws, Taps & Dies, Files and Twist Drills, Blowers & Forges, Machinery, Tools & Hardware, Gear Wheels, Wood Pulleys, Shafting, Hangers & Belting. General factory supplies.
"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including August 29, 1889 issue, 84 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.
"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 98 articles have thus far appeared up to and including the August 22, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

The Cleburne (Texas) Foundry and Machine Company has been incorporated.

The Kentucky Union Railway Co. will build machine shops at Lexington, Ky.

The Jefferson Lumber Company will rebuild their planing mill at Kildare, Texas.

A company to be known as The Niagara Paper Co. has been chartered at Lockport, N. Y.

The Birmingham, Powderly & Bessemer Dummy Line Co. will build a repair shop at Powderly, Ala.

The Charleston, Cincinnati & Chicago Railroad Company are building repair shops at Blacksburg, S. C.

The Shultz Belting Co., St. Louis, Mo., have increased their facility for manufacture 25 per cent.

The Chattanooga (Tenn.) Plow Company contemplate putting in an automatic engine, about 18" cylinder.

The Sharon (Maine) Water Power Co. is building a dam, and it is the intention to induce manufacturers to locate there.

The Virginia Steel Company will put in a plant for making charcoal, wood alcohol, acetate of lime, etc., at Alexandria, Va.

The Chicago, St. Paul & Kansas City Railroad expect to expend $250,000 in building and equipping shops at St. Joseph, Mo.

F. W. Mumby is organizing a $50,000 stock company, at Jacksonville, Fla., to manufacture furniture, coffins and woodenware.

The village of Williamstown, Vt., will exempt from taxation for a period of five years any manufacturing industry that will locate there.

The Ohio & Michigan Anglo-American Storage Battery Company, East Saginaw, Mich., has been incorporated, with $1,500,000 capital.

An improvement committee has been organized at Helena, Ark., and will make efforts to have established a wagon factory, canning factory, furniture factory and cotton mill.

Owing to the very low water, several of the mills at Livermore Falls, Me., have been obliged to shut down a portion of their wheels, there not being water enough to run all the machinery.

Wm. L. Simpson, New York agent for the Buckeye Engine Co., says the engine trade is good. He has "sold seven engines during the past ten days, and not little ones either, but all big ones."

The East Shore Novelty Manufacturing Co. has been incorporated at North Muskegon, Mich., to engage in the manufacture of woven wire frames, rough rolls, step ladders, cloth boards, bed slats, etc.

Wm. D. Troutner, Pittsfield, Ill., writes us that he has established himself in the machine and foundry business for doing steam engine and other repairing, and for making special and other machinery.

The machinery of the Co-operative Furniture Company at Athol, Mass., has been sold to John A. Terry, of Petersham, and Monroe Cheney has leased the shop to him. He will manufacture builders' finish and chair stock.

A cotton mill is now building at Spartanburg, S. C. It will have 30,000 spindles and 1,100 looms, and about 600 operatives will be employed. The capital stock of the company is $500,000. A fine grade of goods will be manufactured.

The Cohannet Corporation will soon commence the erection of a new mill at Wier Village, near Taunton, Mass. The new mill will be as large, if not larger, than the present Cohannet mill. It will be devoted to the manufacture of cotton yarns.

The town of Cambridge, O., has made an engagement with capitalists of New Philadelphia, by which they will construct a rolling mill in Cambridge to employ 125 hands. Natural gas will be used as fuel, and the town gives a bonus of $20,000.

The cotton factory building one mile north of Canton, Miss., which has been unoccupied for some years, has been purchased by the State Alliance for the purpose of fitting it up for a bagging factory. The Alliance proposes to put $50,000 into the enterprise.

The Chicago (Ill.) Railway Metal Tie Company has been incorporated. The company proposes to manufacture metallic railway ties and fastenings, and other railway supplies; capital stock, $200,000; incorporators, William D. Petherick, William J. Kenny and F. Newton Rice.

The Fiberwood Company have contracted for the erection of buildings at Livermore Falls, N. H. The buildings include a main factory, a pulp mill, a boiler house and a treatment house, and are to be finished, under the terms of the contract, on or before December 1. Work has already been begun.

The National Pipe Bending Co., New Haven, Conn., recently shipped two 400 horse-power feed water heaters to Osaka, Japan, for the electric light station there. This company sold 45 heaters during the month of August, ranging from 150 to 800 horse-power. Their heaters go to all parts of the country, from Maine to California.

The Moosehead Paper and Pulp Company has bought the water privilege and land on both sides of the Kennebec River, Me., four hundred feet above the Carratunk Falls. The incorporators of the company are R. C. Clements, of Rutland, Vt.; Stanton Day, of Boston, and D. T. Mills, a patentee of pulp machinery. The company will erect a stone mill, 120x70 feet, two and a half stories high, with a capacity of twenty tons of wood pulp per day.

Articles of incorporation have been filed for the Sioux City (Ia.) Starch and Glucose Works, with a paid-up capital of $100,000. The building will be located at Leeds, and will be 220 feet in length, 94 feet frontage and three and one-half stories, or 56 feet high, and it is expected that the plant will be completed and in readiness to receive the raw product by December. The works, when in full operation, will give employment to considerably over 100 men.

There is water-works agitation at Princeton, Ill.; Atlanta, Ga.; Griffin, Ga.; Winchester, Ky.; Crawford, Neb.; Union, S. C.; Hooper, Neb.; Howard City, Mich.; Marshfield, Wis.; Madisonville, Ohio; Canon City, Col.; Antigo, Wis.; Brownsville, Tenn.; Birmingham, Ala.; Lorain, Ohio; Birmingham, Ala.; Princeton, Ill.; Ainsworth, Neb.; Fossie, Ore.; Moscow, W. T.; Pictou, N. S.; Eureka Springs, Ark.; Weston, W. Va.; Poultney, Vt.; Algona, Iowa; Pine Grove, Pa; Huntington, Ind.; Delta, Cal.

The New York *Tribune* states that a New York company, with large capital, is to build extensive works at West Park, near Findlay, O., for the manufacture of aluminum from clay found in that region. It is stated that crucibles for the manufacture of aluminum are already in course of construction, as well as a large number of dwelling houses to be used by employes, but that the work on the main structures will not be begun until next spring. The company proposes also to manufacture iron and steel.

A press dispatch says: Ferdinand Schlesinger, of Milwaukee, representing the Bliechroder German syndicate, has secured an option for the purchase of the Bessie mine, at Humboldt, and now holds the refusal of a number of the best non-bessemer hematite iron mines of the Marquette range, after purchasing the six leading mines of the Menominee range. The purpose of the syndicate is apparently to buy all the leading non-bessemer mines of Lake Superior district. Four million dollars has already been invested in mines here by this syndicate.

The following dispatch from Portsmouth, N. H., looks like business. The dispatch is dated Sept. 17: Commodore Wilson, in pursuance of orders from Secretary Tracy, visited the navy yard yesterday to ascertain the advantages possessed by the yard for establishing an iron plant and a depot for supplies. It is understood that the commodore heartily favors the project and appreciates the advantages possessed by the Kittery yard, and will set forth the matter in his annual report to the secretary. It is estimated that it will cost $500,000 to establish an iron plant and construct a new patent dry dock.

The Pond Engineering Co., St. Louis, Mo., will furnish the Hutchinson (Kan.) Water, Light and Telephone Co. with a 100 horse-power Armington & Sims engine, being the fourth engine of that make which the company has in their station. It will have a special new feature—a clutch will be placed on the driving wheel, so arranged that, with the engine running steadily, the driving wheel can be run or not, as desired. They will also furnish the Edison Illuminating Co., of Topeka, Kan., with Ireson leather link belting, and the Metropolitan Railway Co., of Kansas city, with a Tracy patent oil filter. This company has been awarded the contract for the pumping engines, boilers, etc., for the Belleville (Kan.) Water Works.

The members of the Farmers' Alliance in the vicinity of Greenville, Ala., are lending a hand to break down the jute trust by the introduction of cotton bagging as a substitute. The latter system is a new one, and farmers are unable as yet to prepare the material, on account of the failure of the factories to supply the demand. Increased facilities are being rapidly adopted for turning it out, and before long cotton bagging will entirely supplant the jute, notwithstanding that a loss of 50 cents or one dollar per bale is sustained by those who use cotton bagging. In some sections pine straw is being woven into bagging, which is said to be much superior to the jute. It is not inflammable, and will protect cotton better than any covering yet brought into use.

Machinists' Supplies and Iron.

NEW YORK, Sept. 21, 1889.

Iron—American Pig.—The supply of some brands has at times during the past week exceeded the demand, and there was a disposition upon the part of holders to make concessions, although prices are not quotably lower. We quote, Standard Northern brands, No. 1 X Foundry, $17 to $18; No. 2, $16 to $17. Southern brands, No. 1, $16.75 to $17.25; No. 2, $16 to $16.50. Northern brands, Grey Forge, $15.25. Southern brands, $15.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

First-class machine pattern maker wants situation. Address Pattern Maker, 2,315 Vine st., Phila., Pa.

Mech. draftsman and designer with practical shop experience, wants position. BOX 26, AM. MACHINIST.

Foundry foreman (machine) wants situation. Address Boomer, AMERICAN MACHINIST.

Wanted—15 good machinists can find steady work at Jones & Lamson Machine Co.'s new shop at Springfield, Vt.

Wanted A mechanical draftsman with a practical knowledge of foundry and machine shop work. Box 93, Albany, N. Y.

A mech. engineer, widely exp'd in designing, estimating, m'f'g, superinten'g, etc., is open for engagement in any location. "Nom," Box 321, Chicago, Ill.

Machinists wanted—Two first-class job hands, and one machinist and blacksmith. Permanent hands. No saloon patrons. J. H. Wells, Tampa, Fla.

Wanted –Mechanical draftsmen on sugar refinery work. Address, stating former experience, E. H., AMERICAN MACHINIST.

Wanted—A position as machine shop foreman, 15 years' experience on engine and general mill work. Address Box 217, Havana, New York.

Wanted—A good mechanical draftsman on engines and mining machinery. State experience, salary, etc. Box 224, Pottsville, Pa.

First-class planer hands and tool makers. Wages $2 to $3 for ten hours. Give full particulars at once. Gisholt Machine Co., Madison, Wis.

Wanted—Two good lathe hands in a shop engaged in the manufacture of wood-working machinery. Married men preferred. Steady work for right men. Jenkins Machine Co., Sheboygan, Wis.

Wanted—A foreman; a good blacksmith, accustomed to the care of a shop, and experienced in the use of forging machines for forging small articles. State age and experience. R. C., AM. MACHINIST.

Wanted—Mechanical draftsman experienced in light machinery and well posted on shop practice. Letter stating age, nationality, experience, and wages expected. Address "South," care AM. MACH.

Wanted—Position as superintendent by one familiar with modern practice, and with several years' experience in wide-awake New England shops. Best references. Box 25, AMERICAN MACHINIST.

Wanted—Position as mech. sup't or general foreman of mach works. Well up in manufacture of Corliss, automatic and high speed engines, refrigerating and heavy mach'y. J. L. M., AMERICAN MACHINIST.

Wanted—Position as draftsman by young man (22) graduated from technical school in Norway, and some experience in machine shop practice in this country. Chance for improvement more of an object than salary. Address W., care AM. MACHINIST.

Wanted—Toolmaker used to fine, accurate work, as foreman; must be able to design labor-saving devices. Good pay and a steady position to the right man. State age, experience, references, etc. BOX 108, AMERICAN MACHINIST.

A machine foreman, designer and draftsman, with experience managing men and shop manufacturing fine tools and interchangeable machinery, wishes to correspond with parties in need of such a man. Address G. W. N., AMERICAN MACHINIST.

Wanted—Foundry foreman. Must be thoroughly competent to take charge of foundry and handle men to good advantage. Address, giving references, and state class of work you have been accustomed to doing, "Foundry," AMERICAN MACHINIST.

Wanted—Two thorough, practical mechanics; one as supt. of machine shop and one as supt. of moulding shop, in iron works doing a general foundry and machine business. To the right parties, having a few thousand dollars to invest, an interest will be given. Address T., care AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d hand Planers, etc. S. M. York, Clev'd., O.

Koopman's Scales for quick measurements.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, O.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, O.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., Consulting Engineer. Designs of all kinds of Machinery.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Complete list of our Scales and other new tools for 2c. stamp. A. T. Koopman, Chicago.

D. J. Kelsey, M. E., Designer of Automatic Machinery, 31 Insurance Building, New Haven, Conn.

Latest and best Planer and Drill Press Chucks, Expanding Mandrels. The Brightman Machine Company, Cleveland, Ohio.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

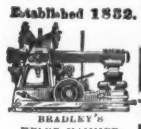
Wanted—To sell patent, or have manufactured on royalty at reasonable figures, Huyett's Drawing Board, illustrated in AMERICAN MACHINIST, Sept. 15, 1888. Address Mrs. D. D. Huyett, Waynesboro, Pa.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Wanted—A grinding machine for finishing flat surface work. Parties building such a machine please send description and price to The Hendey Machine Co., Torrington, Conn.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

Established 1852. BRADLEY'S POWER HAMMERS



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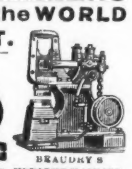

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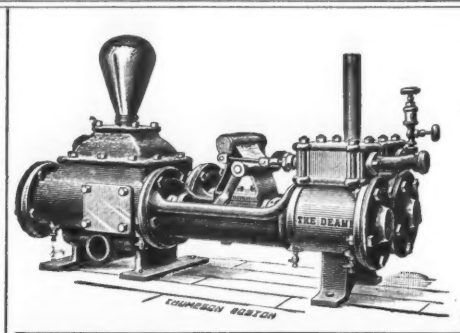

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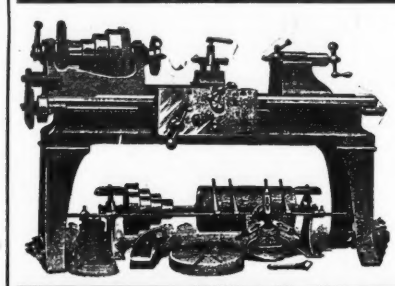

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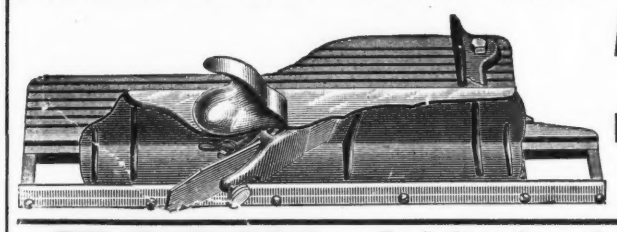

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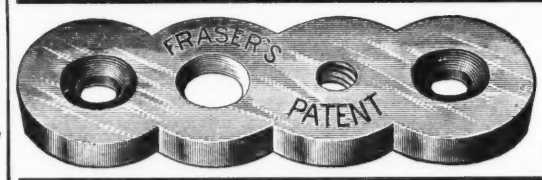

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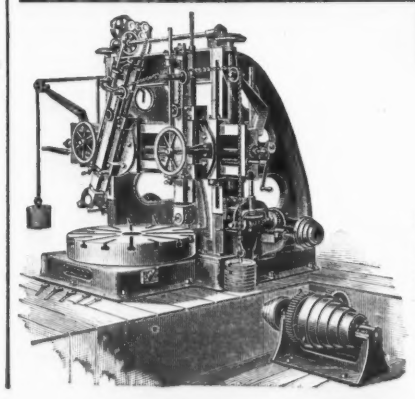

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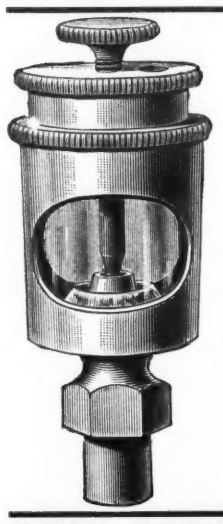

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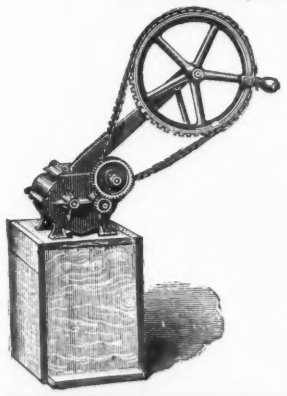

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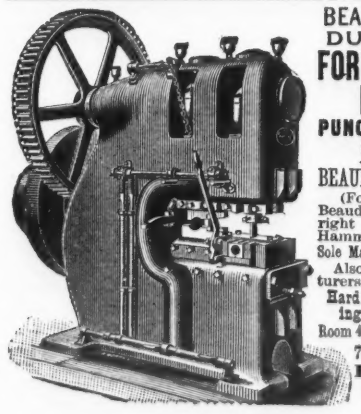

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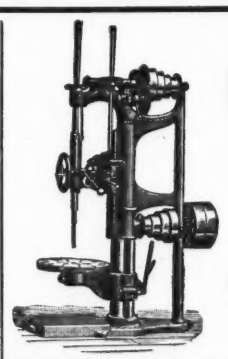

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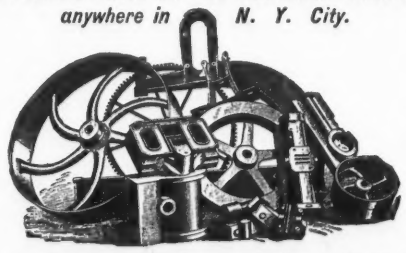

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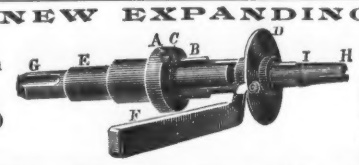

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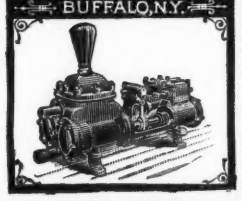

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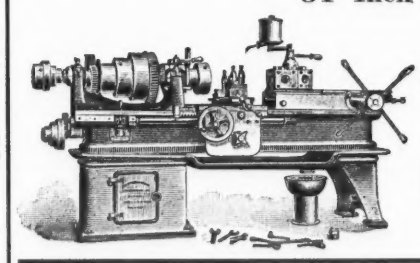

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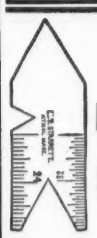

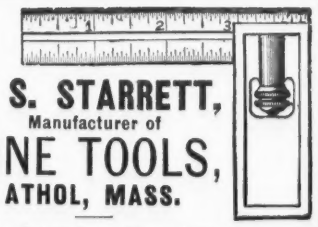

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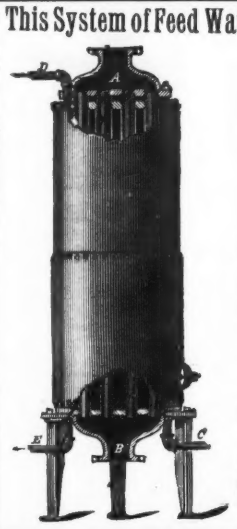

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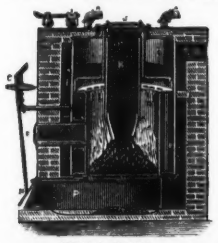

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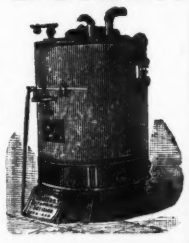

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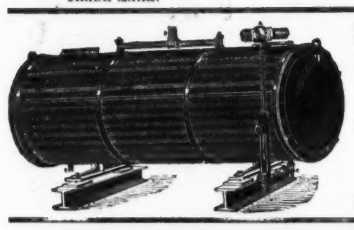

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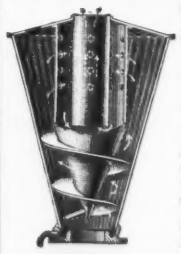

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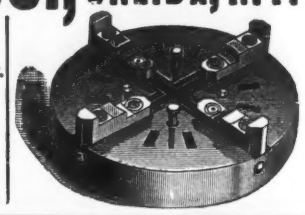

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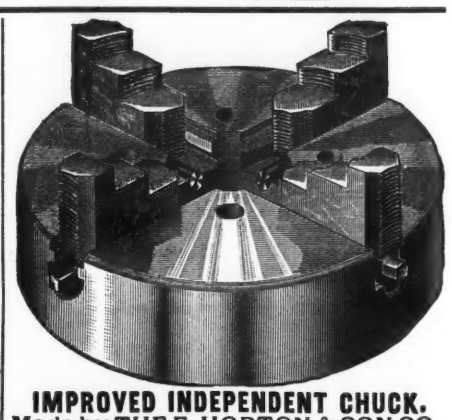

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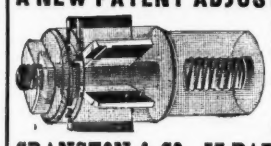

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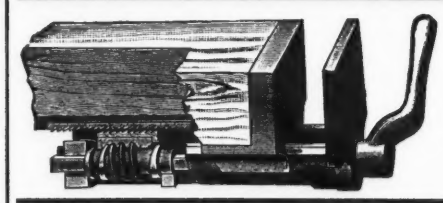

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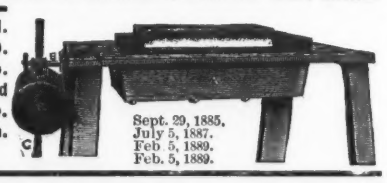

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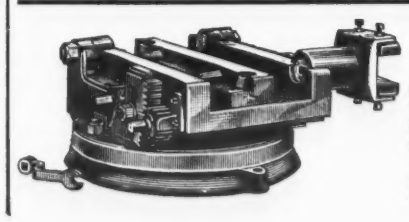

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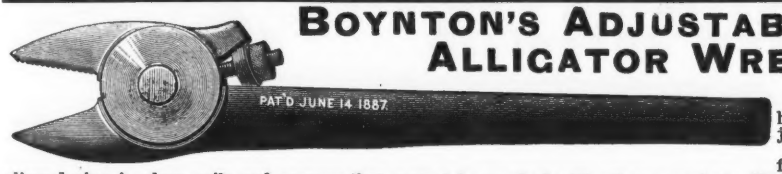

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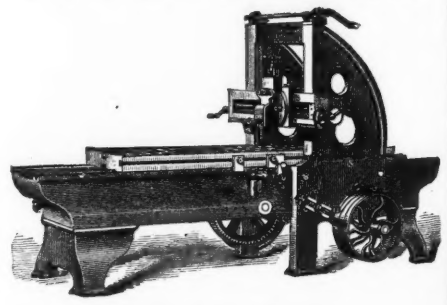

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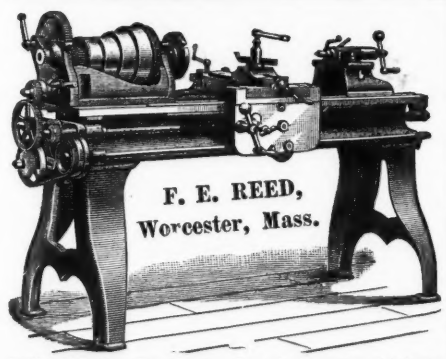

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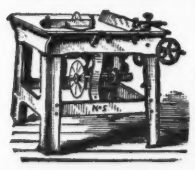

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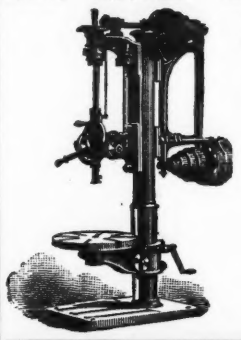

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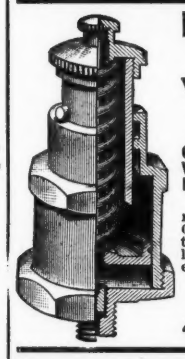

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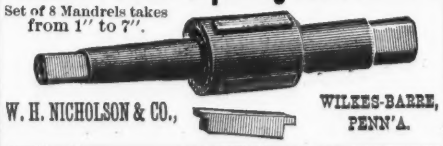

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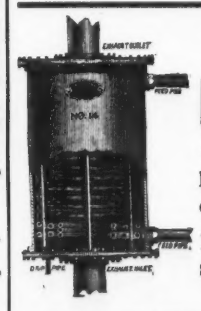

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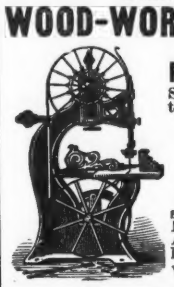

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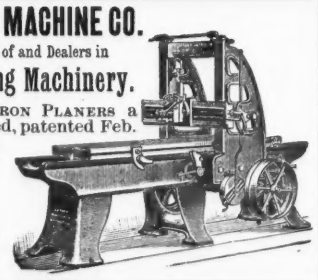

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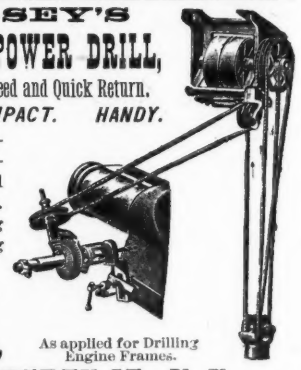

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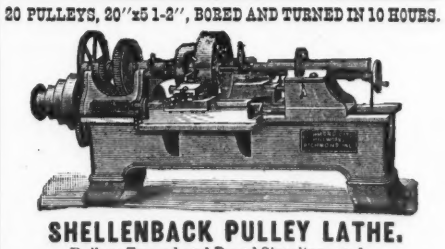

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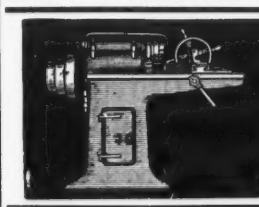

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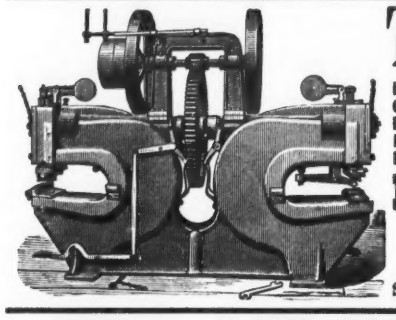

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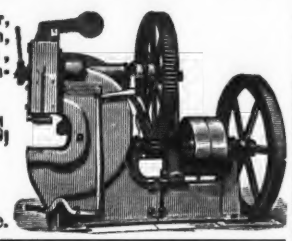

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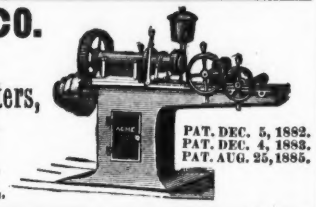

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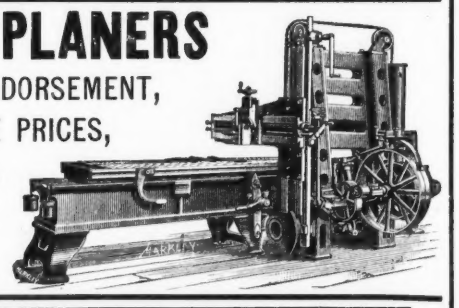

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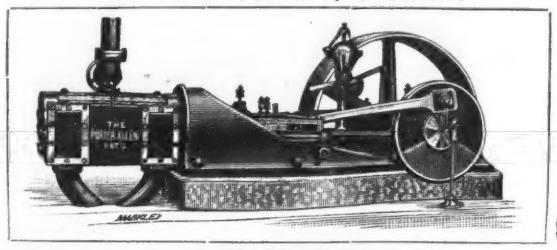

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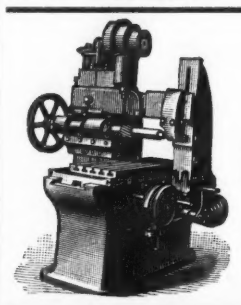

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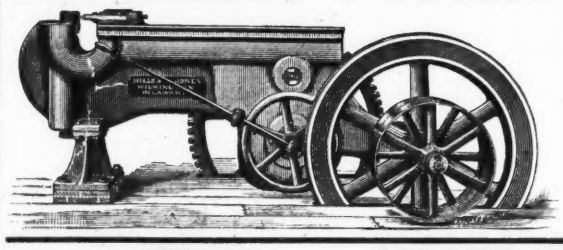

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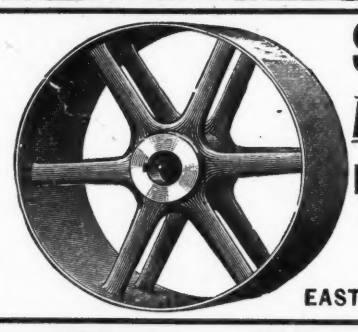

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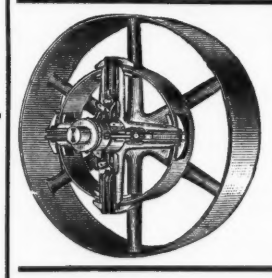

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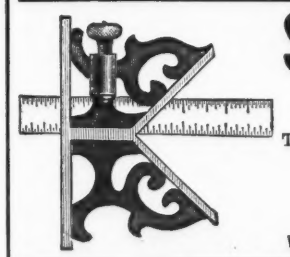

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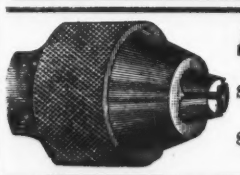

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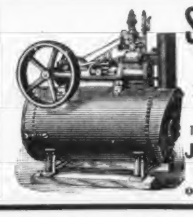

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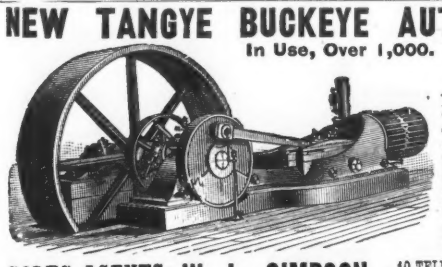

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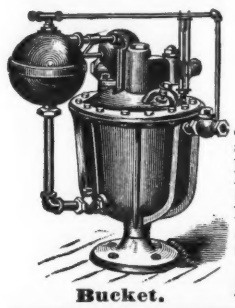

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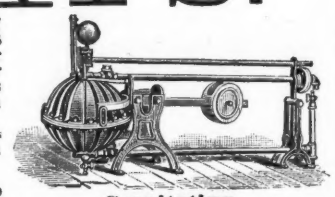

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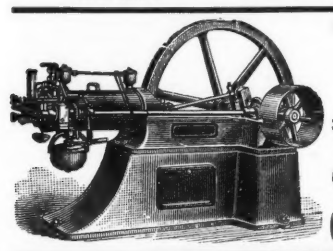

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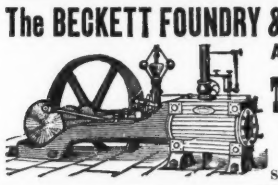

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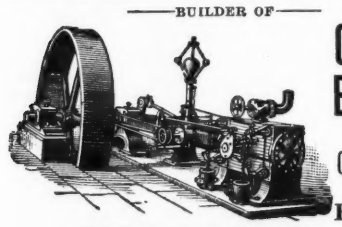

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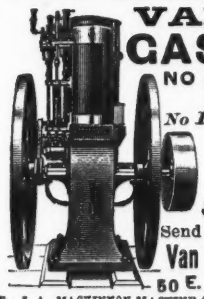

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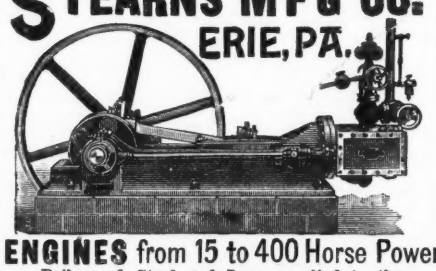

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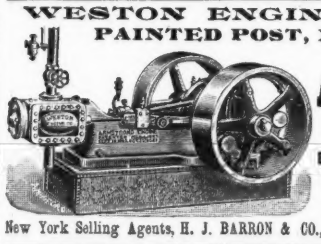

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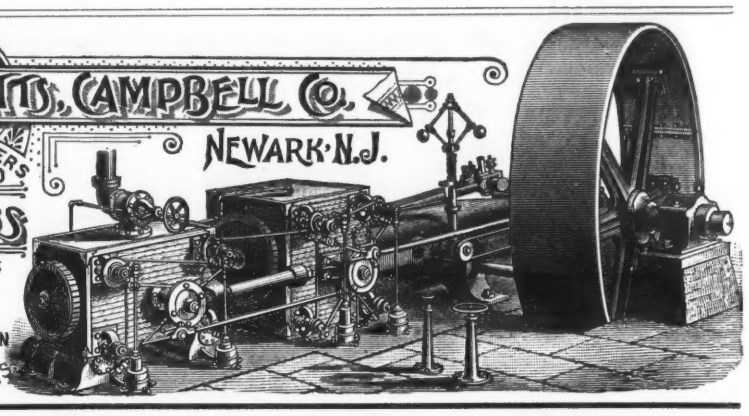

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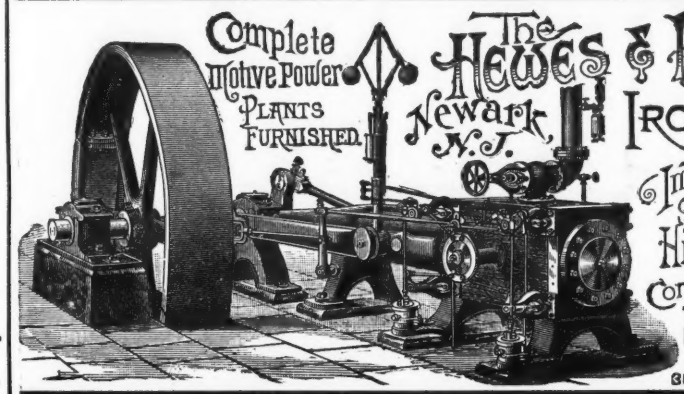

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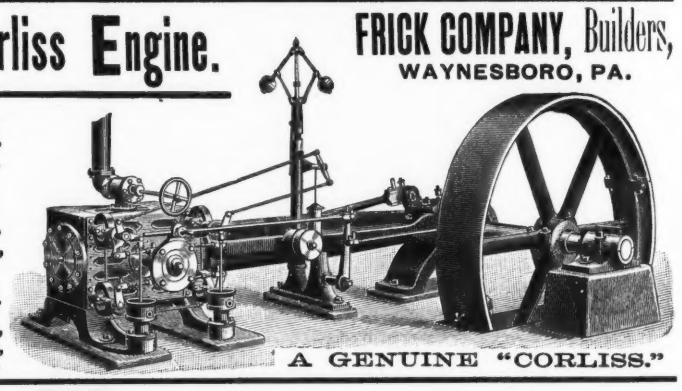

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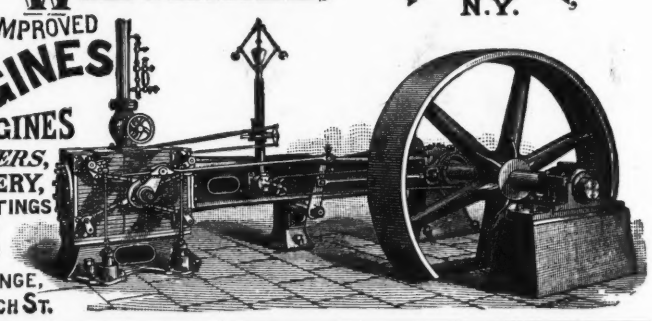

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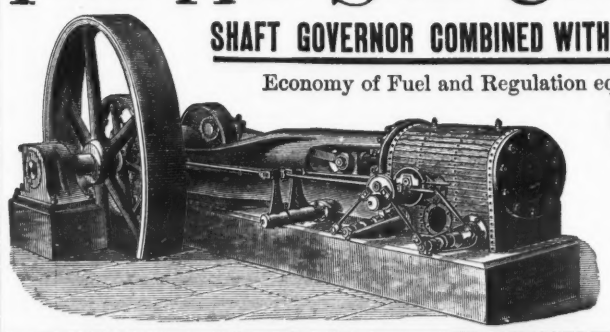

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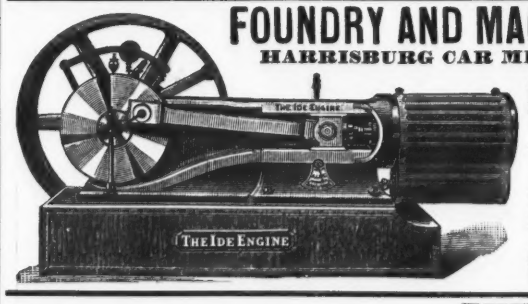

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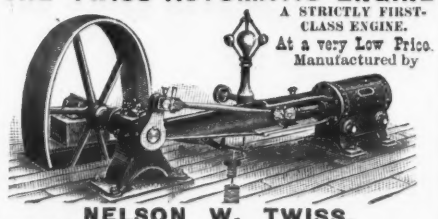

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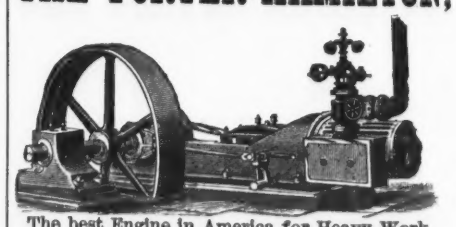

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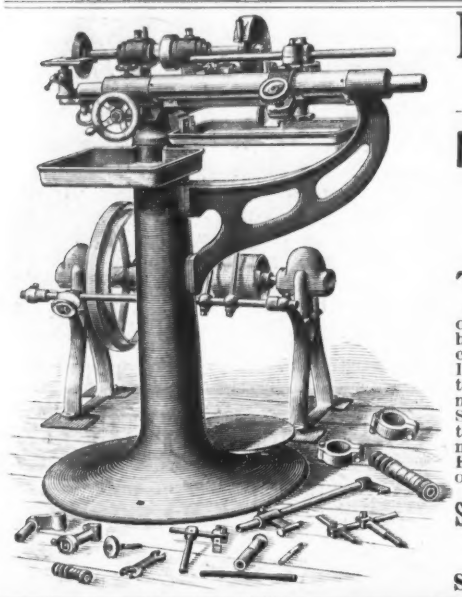

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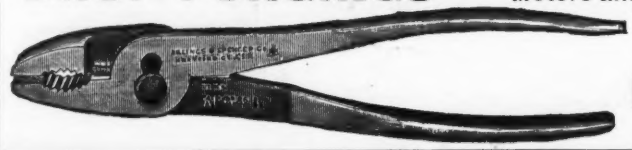

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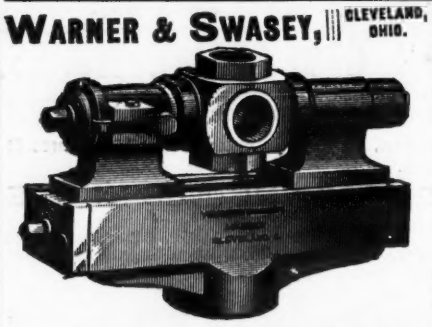

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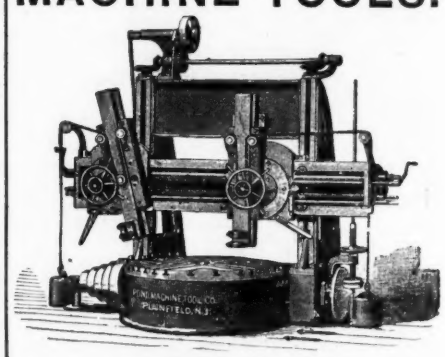

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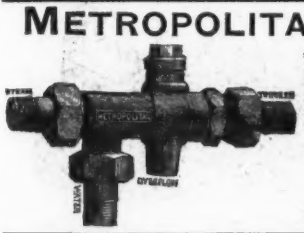

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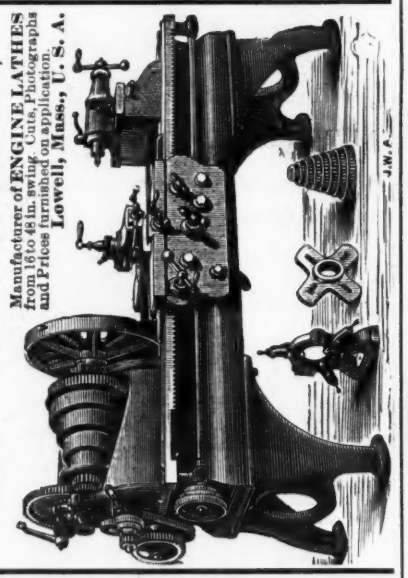

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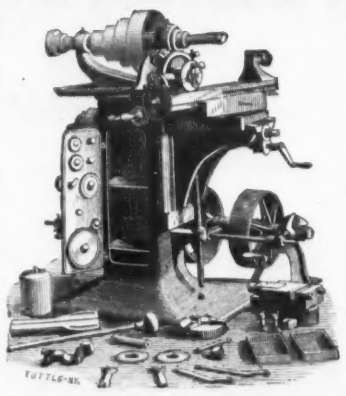

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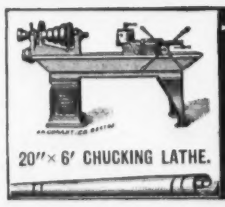

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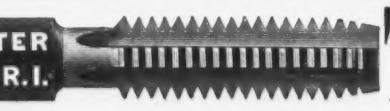

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